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First record of *Chrysotoxum baphyrum* Walker from West Palaearctic (Diptera: Syrphidae), with key to species of *Chrysotoxum* Meigen from Iran

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Abstract. A new species of Syrphidae is recorded from Iran, *Chrysotoxum baphyrum* Walker. This record represents a new species for the Western Palaearctic Region, as *C. baphyrum* is predominantly distributed in India and Southeast Asia. An identification key to the recorded species of *Chrysotoxum* from Iran is provided, as well as newly obtained DNA sequences for *C. baphyrum*.

Key words. Iran, taxonomy, identification key, new record, DNA barcode.

INTRODUCTION

Flies of the genus *Chrysotoxum* Meigen, 1803 are excellent wasp mimics, with long antennae (usually as long as or longer than face), a broad convex abdomen, and a very distinct black and yellow colour pattern. There are many observations on habitat and visited flowers by adults (Speight 2016) and on oviposition (Reemer & Goudsmits 2004), but the precise prey of larvae of *Chrysotoxum* remains unclear. Some previous authors have reported immature stages of *Chrysotoxum* near or in ant nests (Dixon 1960; Speight 1976; Rotheray et al. 1996), suggesting that immatures may live in ant nests and feed on aphids. Other observations reported a similar behaviour (Inouye 1958; Luciano et al. 1989), but the truth is that developmental stages for the majority of species are unknown. Recently, Patil et al. (2013) reported the species, *Chrysotoxum baphyrum* Walker, 1849 feeding on the sugarcane root aphid from northern Karnataka State, peninsular India.

Chrysotoxum species are so distinct from other genera that previous workers have given different ranks, i.e. as a subfamily (Newman 1834; Schiner 1864; Brunetti 1923, or Hull 1949 among other), as a tribe under Syrphinae (Vockeroth 1969), or a subtribe due to its 'aberration' (Shatalkin 1975). Currently, *Chrysotoxum* is placed within the tribe Syrphini (Vockeroth 1992; Mengual et al. 2008) without a clear sister group (Rotheray & Gilbert 1999; Mengual 2015; Mengual et al. 2015). Shannon (1926) divided the genus into two subgenera based on the ratio of the antennal segments, but subsequent authors have not followed his subdivision.

In the Palaearctic Region, there are 87 recognized species of *Chrysotoxum* at present, from a total of 143 published names (Peck 1988; Ghorpadé 2012; Nedeljković et al. 2013, 2015; Thompson 2013; Vujić et al. 2017). There is currently great need for a revision of the species belonging to this genus. Speight (2016) pointed out a fact already mentioned by Coe (1953) and Sommaggio (2001), that "*the male genitalia of many European 'species' of* Chrysotoxum *are equally indistinguishable*". As a consequence, new techniques, molecular data and integrative approaches are being applied to separate species (Masetti et al. 2006; Nedeljković et al. 2013, 2015) and new species are described, mostly from China (Huo & Zheng 2004; Huo et al. 2006; Zhang et al. 2010; Yuan et al. 2011). But a sound taxonomic background is still needed. The Palaearctic species were last revised by Violovitsh (1974), but he did not include all the recognized species at the time and separated females and males in different keys as both sexes were not known for all species.

The syrphid fauna of Iran has been actively studied during the last years (Dousti & Hayat 2006; Gilasian 2007; Naderloo et al. 2013; Naderloo & Pashaei Rad 2014), and as a result some new species (Gilasian & Sorokina 2011; Gilasian et al. 2015) and multiple new records (Gharali & Reemer 2008, 2010; Khaganinia 2010, 2011; Bedoreh & Ansari 2012; Kazerani et al. 2013, 2014a, 2014b; Khaganinia & Hosseini 2013; Vosughian et al. 2013; Khaganinia & Kazerani 2014; Khosravian et al. 2015) have been reported. In Iran, Dousti & Hayat (2006) reported 12 species of *Chrysotoxum* in their catalogue, and more recently, Kazerani et al. (2013) added three more species.

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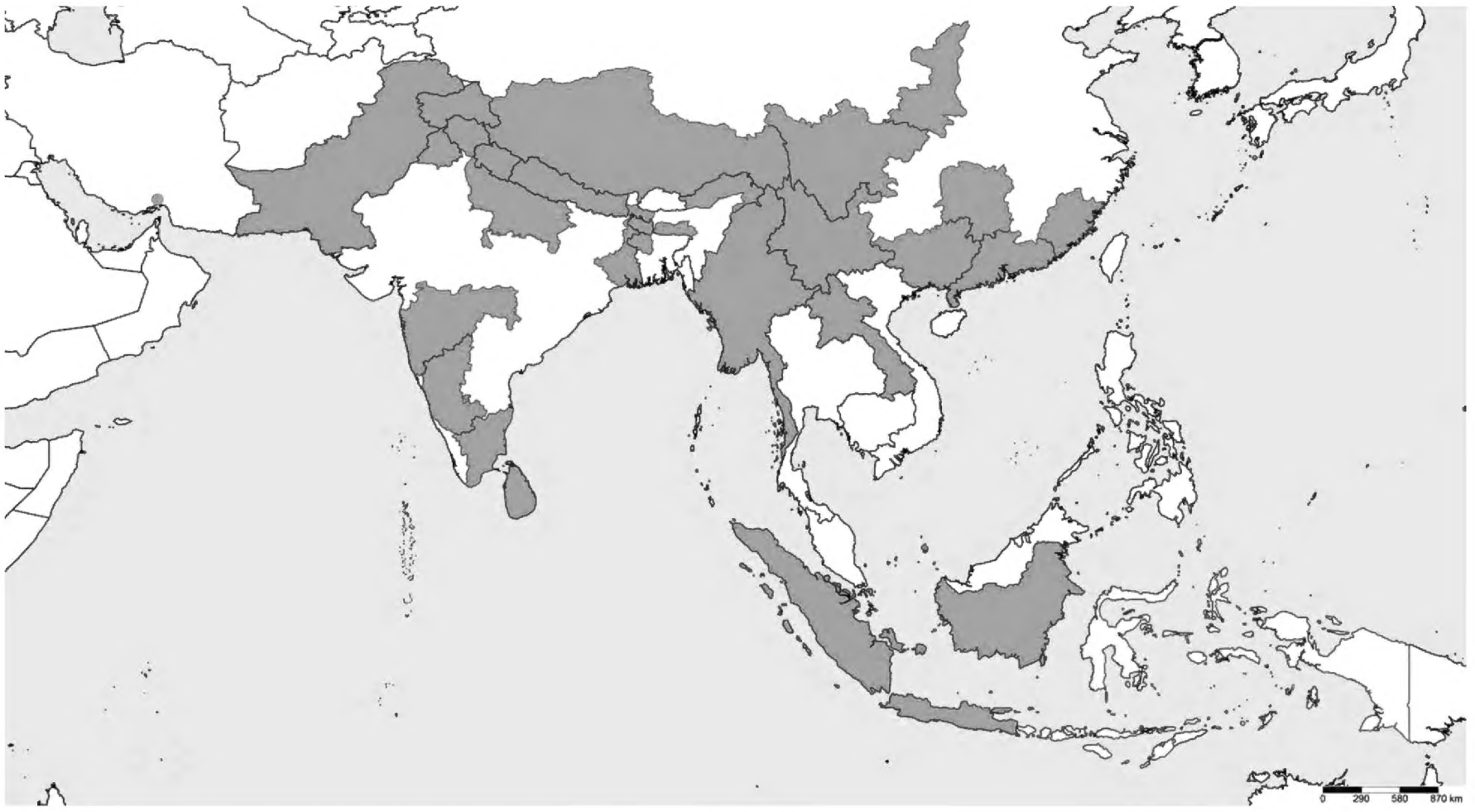


Fig. 1. Map the known geographical distribution of *Chrysotoxum baphyrum*.

Vujić et al. (2017) described a new species from the Middle East, *Chrysotoxum persicum* Vujić, Nedeljković & Hayat, 2017, which is also present in Iran. The present study reports a new species record of this genus for West Palaearctic, *Chrysotoxum baphyrum*. In addition, an identification key is provided for the recorded Iranian species of this genus.

MATERIALS & METHODS

Morphological terminology follows Violovitsh (1974) and Thompson (1999a). In the material examined section, the use of ellipses follows standard English practice and merely indicates that the missing information is the same as that in the preceding record. At the end of each record, between square brackets ([]) and separated by commas, the number of specimens and sex, the holding institution, and the unique identifier or number are given. The abbreviations used for collections and their equivalents are given below:

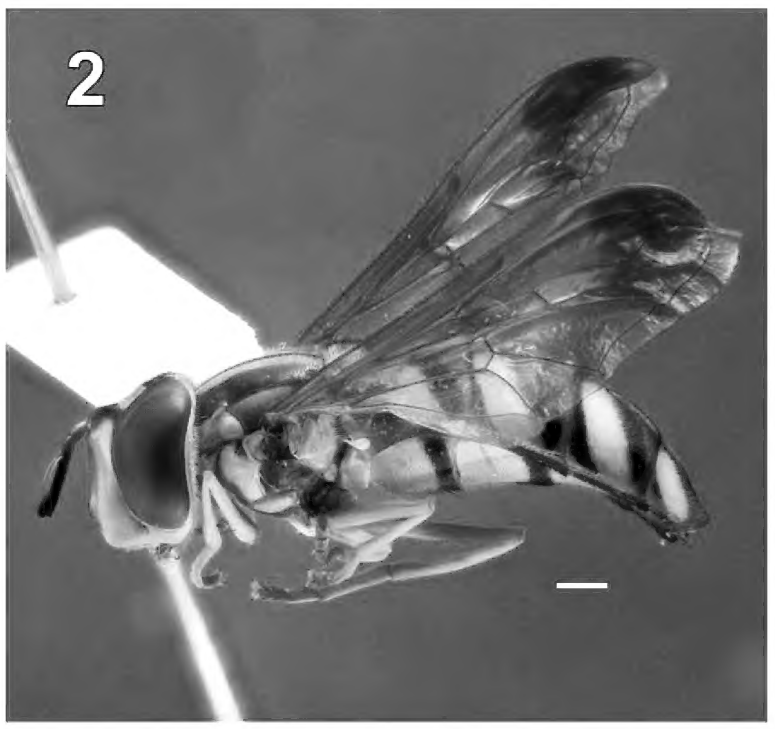
TMUI Department of Entomology, Tarbiat Modares University, Tehran, Iran
ZFMK Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany

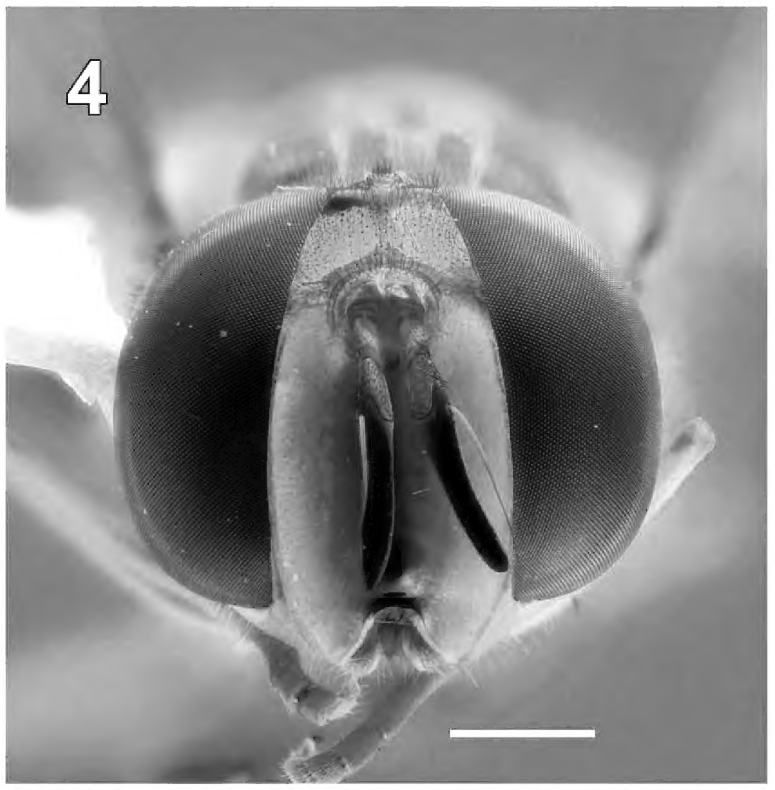
Photographs were composed using the software Zerene Stacker® 1.04 (Richland, Washington, USA), based on images of pinned specimens taken with a Canon EOS 7D® mounted on a P–51 Cam-Lift (Dun Inc., VA, USA) and with the help of Adobe Lightroom® (version 5.6). Figure 1 was created with the help of SimpleMappr (Shorthouse 2010).

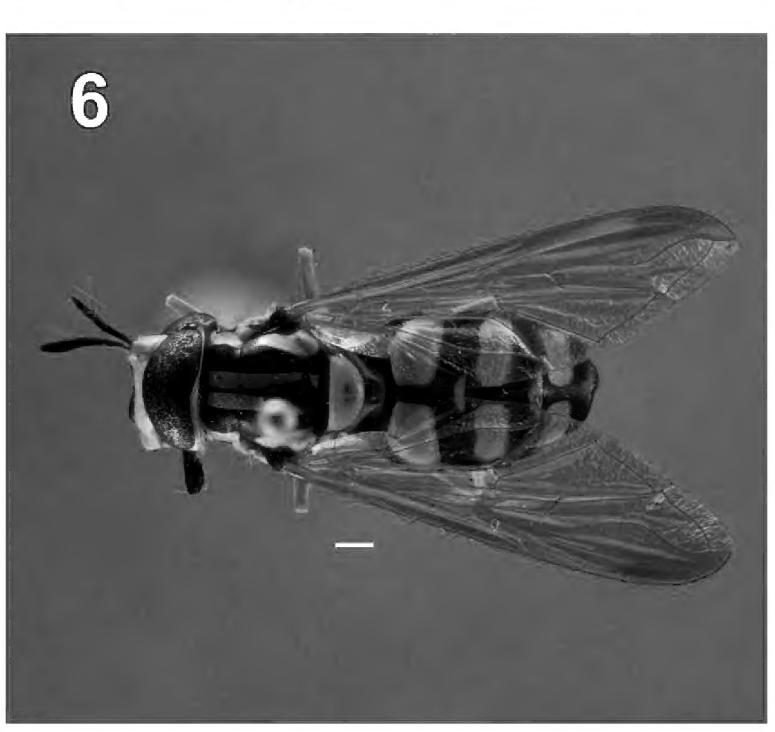
The identification key is based on previous works; i.e., Becker (1921), Sack (1932), Violovitsh (1974), Sommaggio (2001), van Veen (2006), and Speight (2016), with the help of the original descriptions and species checklist. The collected material has been compared with the collections at TMUI, ZFMK and other major natural history museums (USNM: National Museum of Natural History, Washington DC; BMNH: The Natural History Museum, London; RMNH: Naturalis Biodiversity Center, Leiden), and all the recorded species from the literature have been included.

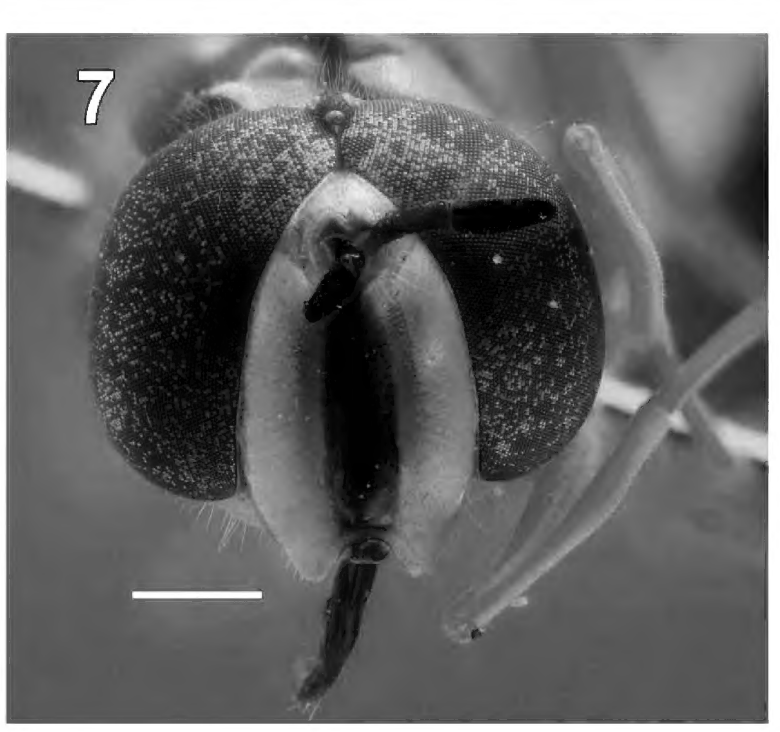
RESULTS

During the course of the survey to provide an initial taxonomic insight on the genus *Chrysotoxum* for Iran, Malaise traps were used during 2010–2012 to collect specimens from different habitats in several Iranian provinces. Among the available material, five female specimens collected in the southern Hormozgan province were studied (Fig. 1). They were identified as *Chrysotoxum baphyrum* (see Ghorpadé 2012 for the justified emendation of the original name *baphyrus*), a widespread species on the In-









Figs 2–7. *Chrysotoxum baphyrum* Walker, female ZFMK-DIP-00018044. 2 – lateral view. 3 – dorsal view. 4 – frontal view. *Chrysotoxum bicinctum* (Linnaeus), female ZFMK-DIP-00018047. 5 – dorsal view. *Chrysotoxum parmense* Rondani, male ZFMK-DIP-00017469. 6 – dorsal view. 7 – frontal view. Scale bars = 1 mm.

dian subcontinent, representing the first record of this Indomalayan species in the West Palaearctic Region. Brunetti (1923), Ghorpadé (1994) and Huo et al. (2007) were used to key out these specimens, which agreed with the original description and cannot be keyed out using current Palaearctic identification keys. The type material of *C. baphyrum* was not studied. The material of *C. baphyrum* was then compared with specimens at the ZFMK collected in India and Pakistan. Although only five females were collected, these can be without doubt determined as *C. baphyrum* by some morphological characteristics unique to this taxon, such as basoflagellomere long (longer than scape and pedicel together), gena yellow, scutum with a complete lateral yellow vitta from postpronotum to scutellum, and abdominal pattern reduced, less dark than other species (see Differential diagnosis below).

Chrysotoxum baphyrum Walker, 1849

Chrysotoxum baphyrus Walker, 1849: 542. Type locality: North Bengal, between India and Bangladesh.
Figs 2–4

Differential diagnosis. Scape and pedicel light brown to orange with black hairs dorsally, basoflagellomere darker, black, about 1.5 times as long as scape and pedicel together (Figs 2, 4). Scutum with two dorsomedial, long yellowish pollinose vittae almost reaching the posterior margin (Fig. 3), with a complete lateral yellow vitta. Abdomen mostly orange, dark markings reduced; lateral margin of abdomen yellow; terga 2–5 each with a pair of medial, broad, paler maculae, with traces of black fasciate maculae on posterior margin of the pale maculae (Fig. 3).

Material examined. IRAN: Hormozgan province, Bandar Abbas, Zakin, 27°49′37″ N 56°18′24″ E, 1122 m, 12.ii.2012, A. Ameri [1 ♀, TMUI]; ..., 25.iv.2012, ... [2 ♀, TMUI] ..., vi.2011, ... [2 ♀, ZFMK, ZFMK-DIP-00018044, ...18045].

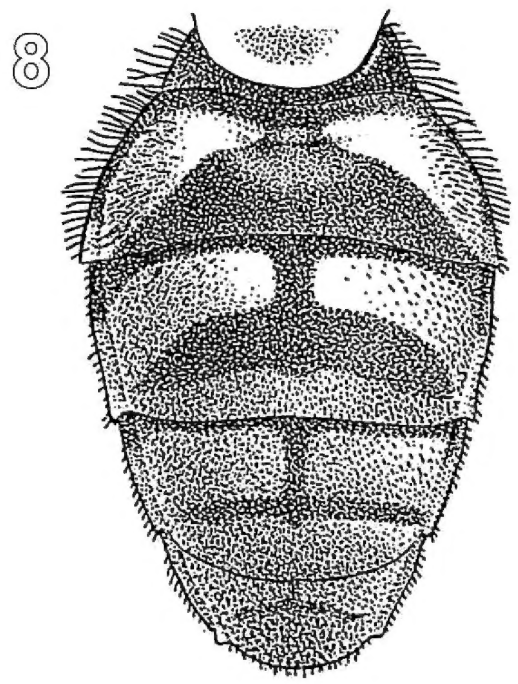
Genetics. The GenBank accession numbers for the specimen ZFMK-DIP-00018045 (Lab code ZFMK_D278) are: 28S gene (KY315697), 18S gene (KY315696), and COI gene (KY315698). This is the first time that *C. baphyrum* is barcoded, but we hope that more barcodes become available (especially from near the type locality) in the near future and further analyses and comparisons can be done.

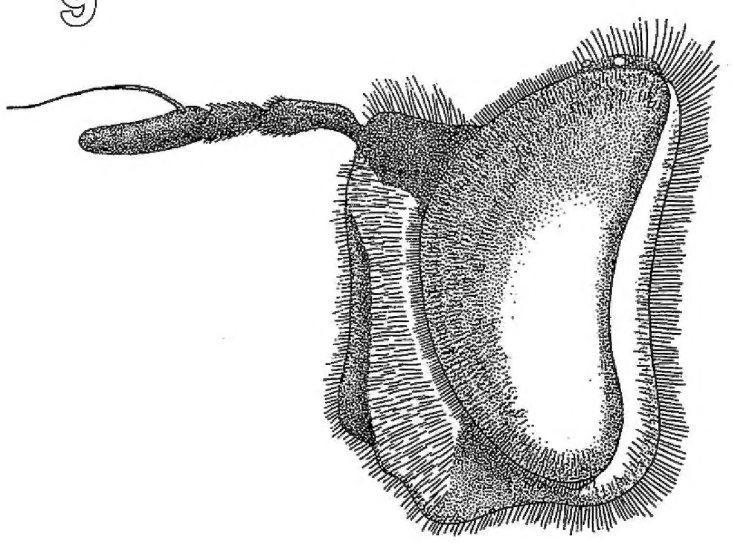
Distribution. The type locality of *C. baphyrum* is North Bengal, a term used for the north-western part of Bangladesh and northern part of West Bengal in India. The Bangladesh part denotes the Rajshahi Division and Rangpur Division. This species has been previously recorded from China (Huo et al. 2007), Pakistan, Sri Lanka, India (Arunachal Pradesh, Chandigarh, Himachal Pradesh, Jammu & Kashmir, Karnataka, Maharastra, Meghalaya, Punjab, Tamil Nadu, Uttarakhand, North Bengal, West Bengal, Uttar Pradesh), Bangladesh, Nepal, Myanmar, Laos, and Indonesia (Java is mentioned in the literature but might be present in other regions, although not recorded eastwards of the Wallace line) (Ghorpadé 1994, 2012, 2014; Huo et al. 2007; Thompson 2013; Mitra et al. 2015).

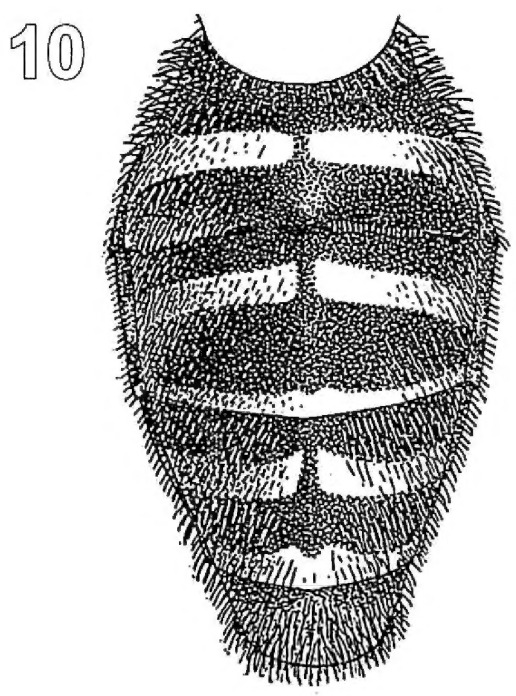
Key to *Chrysotoxum* species in Iran

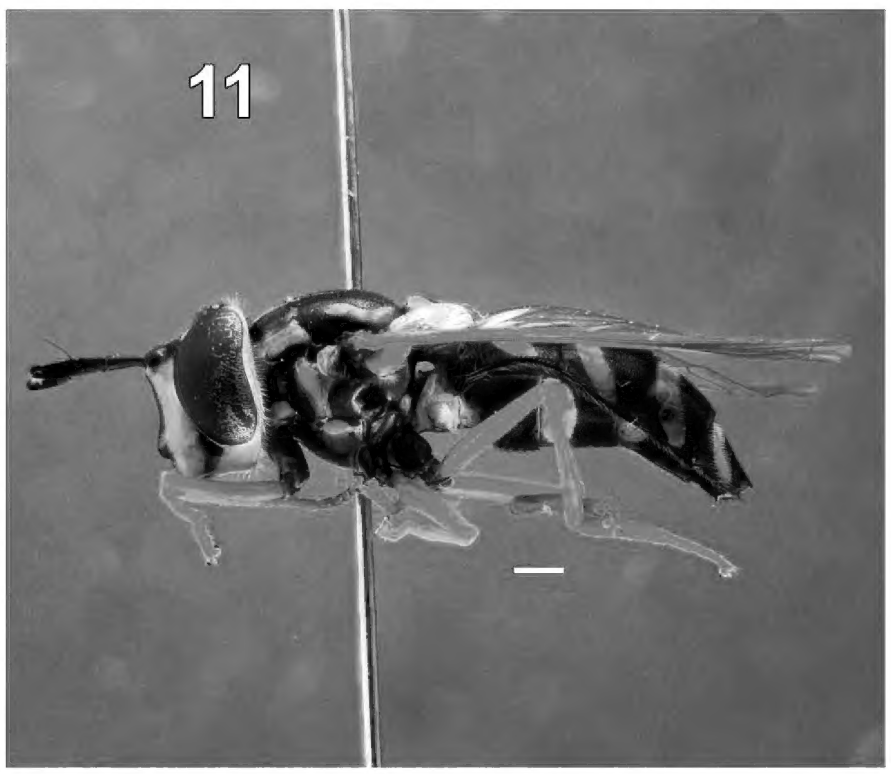
This identification key is based on recorded species from Iran in the literature plus our new records. The images to illustrate the key may not be from Iranian specimens.

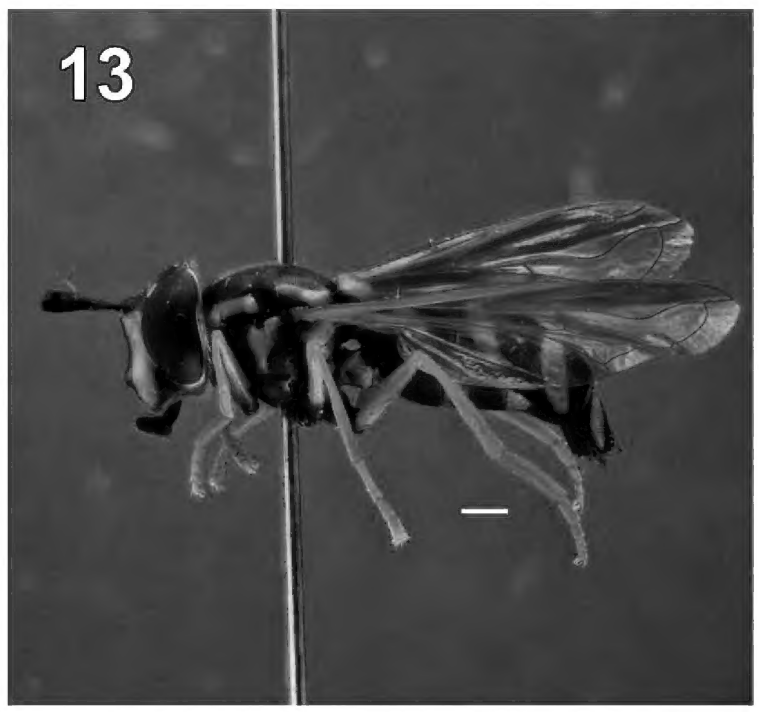
1 Antennal basoflagellomere long, as long as or longer than scape and pedicel combined (Figs 2, 4) 13
– Antennal basoflagellomere short, distinctly shorter than scape and pedicel combined (Figs 5, 7, 9, 11) 2
2 Median black facial vitta incomplete, not reaching antennal bases; only basal 2/3 of face length occupied by black vitta, not present on dorsal 1/3 (abdomen as in Fig. 8) ... ... ***C. robustum*** Portschinsky
– Median black facial vitta complete, reaching or nearly reaching base of antennae (Fig. 7) 3
3 Abdomen with distinct yellow fasciate maculae on terga 2 and 4 only; tergum 3 entirely black or with narrow yellow markings (less than half width of those on tergum 4) (Fig. 5) ... ... ***C. bicinctum*** (Linnaeus)
– Abdominal terga 2–5 with yellow, usually interrupted, fasciate maculae of equal width; tergum 3 with yellow markings as wide as those on tergum 4 (Figs 12, 14) 4
4 Frons yellow (Figs 6, 7); scutum shiny black with two dorsomedial broad pale pollinose vittae that almost reach scutellum (Fig. 6) ... ... ***C. parmense*** Rondani
– Frons black (Figs 11, 13); scutum shiny black with two dorsomedial narrow pale pollinose vittae, usually ending at transverse suture or after, but never beyond anterior 2/3 of scutum (Figs 12, 14) 5
5 Anterior part of frons projecting prominently upwards (Fig. 9); yellow markings on terga 2–4 very similar, not arcuate, with anterior margin of fasciate vittae parallel to anterior margin of tergum (Fig. 10) ... ... ***C. coreanum*** Shiraki
– Frons of usual shape, anterior part of frons not projecting upwards (Fig. 11); yellow markings on terga 2–4 somehow arcuate (Figs 12, 14) 6
6 Lateral margin of abdomen alternately black and yellow (Figs 14, 19) 8
– Lateral margin of abdomen black, yellow fasciate vittae not reaching margin (Figs 11, 12) 7



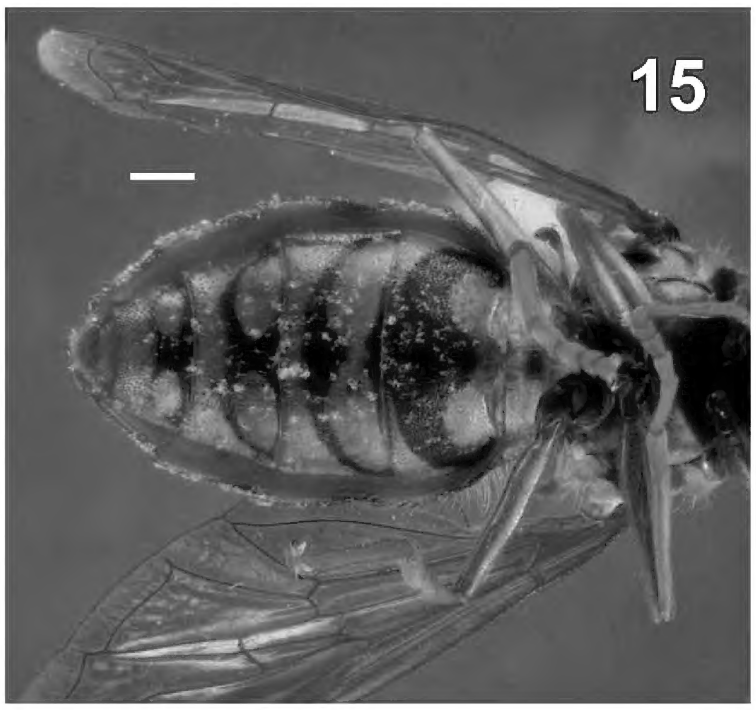


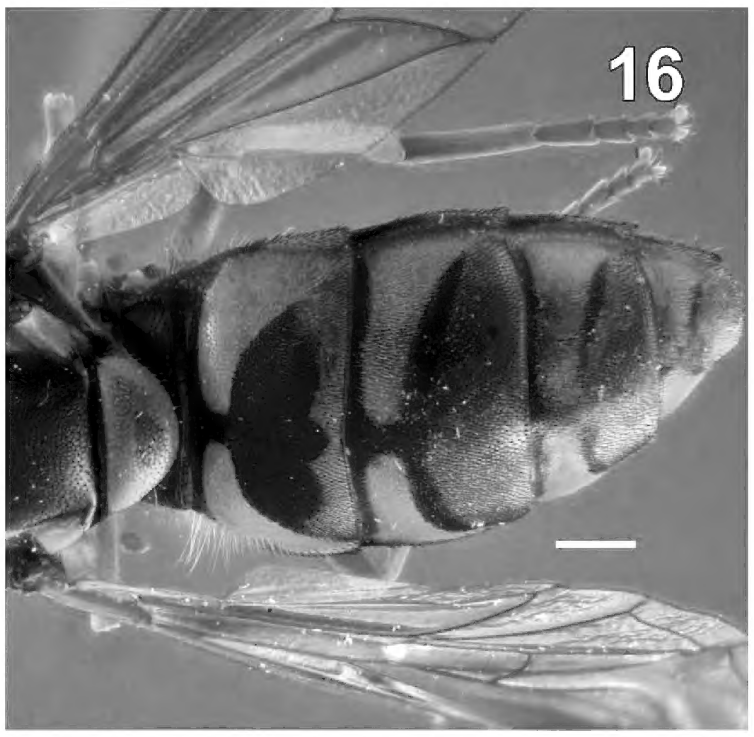


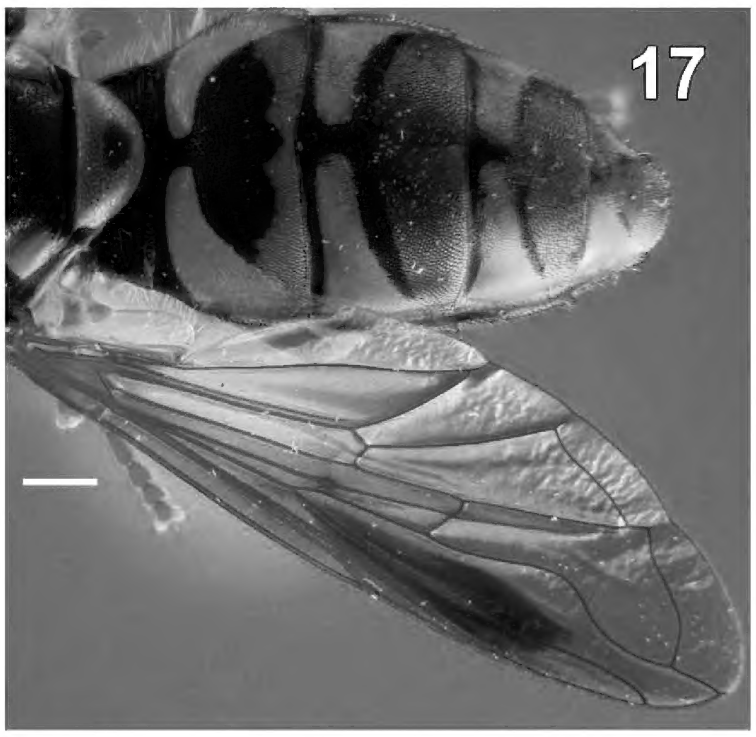


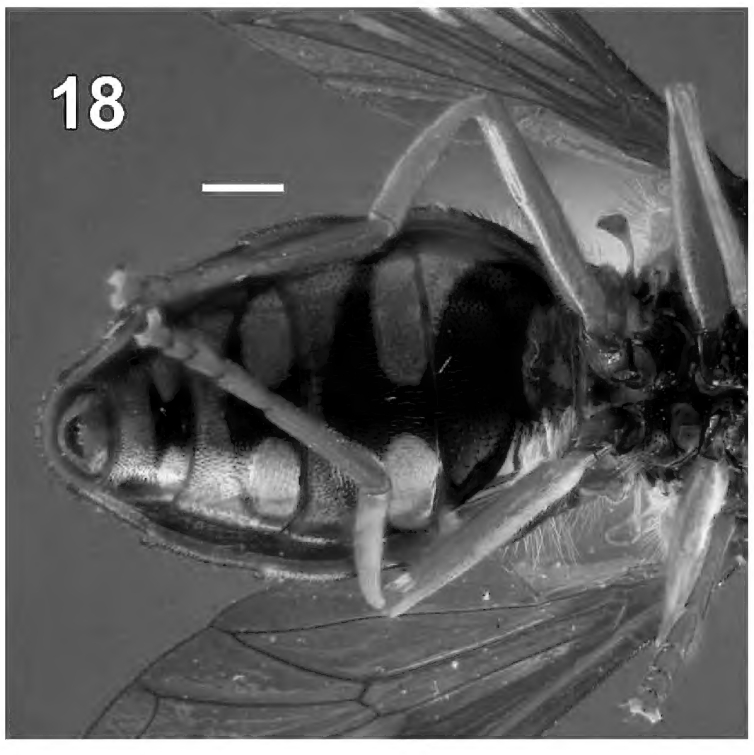


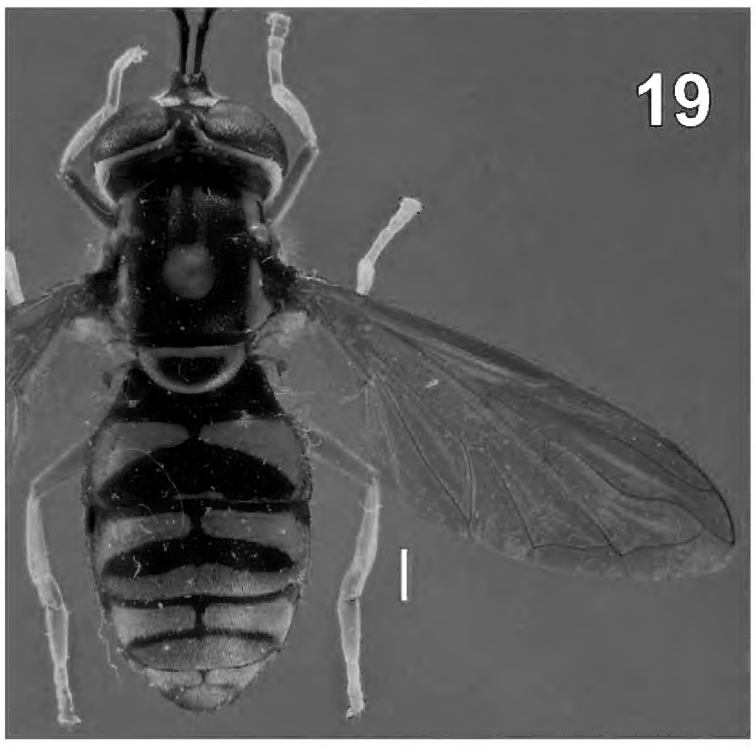
Figs 8–13. *Chrysotoxum robustum* Portschinsky. 8 – abdomen (from Violovitsh 1974). *Chrysotoxum coreanum* Shiraki. 9 – head, lateral view (from Violovitsh 1974). 10 – abdomen (from Violovitsh 1974). *Chrysotoxum festivum* (Linnaeus), female ZFMK-DIP-00017473. 11 – lateral view. 12 – dorsal view. *Chrysotoxum vernale* Loew, female ZFMK-DIP-00017476. 13 – lateral view. Scale bars = 1 mm.





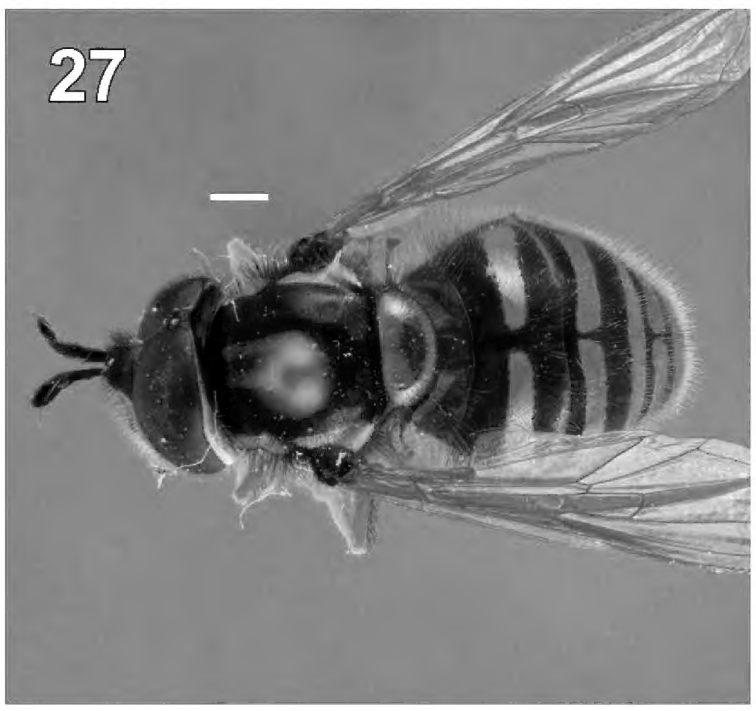


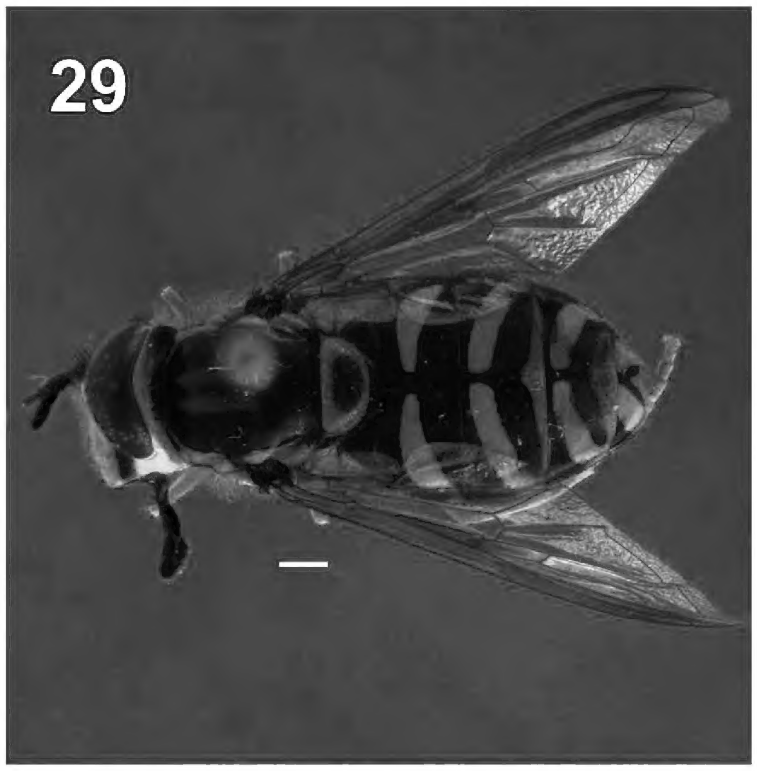




Figs 14–19. *Chrysotoxum octomaculatum* Curtis, female CEUA00019589. 14 – dorsolateral view. *Chrysotoxum octomaculatum* Curtis, female CEUA00082597. 15 – abdomen, ventral view. *Chrysotoxum persicum* Vujić, Nedeljković & Hayat, paratype female ZFMK-DIP-00018048. 16 – abdomen, dorsolateral view. 17 – wing and abdomen. 18 – abdomen, ventral view. *Chrysotoxum verralli* Collin, female ZFMK-DIP-00017471. 19 – dorsal view. Scale bars = 1 mm.

Figs 20–25. *Chrysotoxum elegans* Loew, female ZFMK-DIP-00017470. 20 – dorsal view. *Chrysotoxum montivagum* Violovitsh, female ZFMK-DIP-00018049. 21 – abdomen, dorsal view. 22 – wing. *Chrysotoxum* sp., female from Qazi Chak, ZFMK-DIP-00018050. 23 – dorsal view. *Chrysotoxum cautum* (Harris). 24 – male ZFMK-DIP-00017464, lateral view. 25 – female ZFMK-DIP-00017468, posterior view. Scale bars = 1 mm.





Figs 26–31. *Chrysotoxum arcuatum* (Linnaeus). 26 – female ZFMK-DIP-00018046, lateral view. 27 – male ZFMK-DIP-00017472, dorsal view. *Chrysotoxum bactrianum* Violovitsh, female. 28 – dorsal view. *Chrysotoxum lessonae* Giglio-Tos, male ZFMK-DIP-00017475. 29 – dorsal view. 30 – ventral view. *Chrysotoxum intermedium* Meigen, male ZFMK-DIP-00017474. 31 – ventral view. Scale bars = 1 mm.

7 Pro- and mesofemur completely yellow (Fig. 11); katepisternum usually with dorsal yellow macula (Fig. 11) ……………………………… ***C. festivum*** (Linnaeus)
– At least bases of pro- and mesofemur black; katepisternum usually without dorsal yellow macula; if present, size smaller than posterior spiracle (Fig. 13) ……………………………………… ***C. vernale*** Loew
8 Terga 3 and 4 with black anterior margin not interrupted, continuously black. Tergum 5 with anterior black fascia reaching lateral margin; if not, lateral margin yellow (Fig. 19) ……………………………………… 10
– Terga 3 and/or 4 with black anterior margin interrupted at lateral margin by yellow vitta; lateral margin partly black (Figs 14, 16); although variable, most specimens exhibit this feature on at least one tergum. Tergum 5 with anterior black fascia also interrupted, sometimes lateral margin entirely yellow (Fig. 14) ………………………………………………………… 9
9 Wing with anterior margin yellow, without dark macula; wing tip hyaline (Fig. 14). Terga 3 and 4 with black anterior margin broader towards lateral margin because anterior margin of yellow maculae does not follow tergum anterior margin (Fig. 14); sternum 2 black, except posterolateral corners yellow, with two anterior large yellow maculae (joined medially or not) occupying at least 1/3 of sternum length (Fig. 15). Male genitalia: surstylus less elongated, about 3 times longer than wide ……………… ***C. octomaculatum*** Curtis
– Wing with anterior margin yellow, with clear dark macula between end of R_1 and undulation of R_{4+5}; wing tip hyaline (Fig. 17). Terga 3 and 4 with black anterior margin very narrow, of equal width over much of its length because anterior margin of yellow macula follows tergum anterior margin closely (Figs 16, 17); sternum 2 black, except posterolateral corners yellow, with two very small anterior yellow maculae occupying less than 1/4 of sternum length (Fig. 18). Male genitalia: surstylus elongate, about 4 times longer than wide ………… ***C. persicum*** Vujić, Nedeljković & Hayat
10 Wing with darkened anterior margin, yellow, without subapical dark macula (Fig. 19) ……………………… 12
– Wing with darkened anterior margin, yellow to brownish, with subapical dark macula (Fig 22) ………… 11
11 Scutellum yellow with medial black macula (Figs 21, 22) ………………………… ***C. montivagum*** Violovitsh
– Scutellum black with posterior margin yellow (Fig. 23) ………… ***Chrysotoxum* sp.** (female from Qazi Chak)
12 Tergum 2 with black anterior margin broader towards lateral margin because anterior margin of yellow maculae does not follow anterior margin of tergum (Fig. 20) ……………………………………… ***C. elegans*** Loew
– Tergum 2 with black anterior margin of equal width over much of length because anterior margin of yellow macula follows closely anterior margin of tergum, separated only at side margin (Fig. 19) ……………………………………………… ***C. verralli*** Collin
13 Gena yellow, without black vitta (Figs 2, 4); mesonotum with lateral yellow vitta complete, uninterrupted (Fig. 3) …………………………… ***C. baphyrum*** Walker
– Gena with black vitta (Figs 24, 29); mesonotum with lateral yellow vitta interrupted at transverse suture (Figs 24, 26) ……………………………………………… 14
14 Male: genitalia very large, protruding ventrally in lateral view; postabdomen (abdominal segments posterior of sternum 4) greatly enlarged (Fig. 24). Female: tergum 6 with longitudinal, median membranous slit (Fig. 25) ………………………… ***C. cautum*** (Harris)
– Male: genitalia smaller, not visible in lateral view; postabdomen not enlarged (Figs 30, 31). Female: tergum 6 without membranous slit ……………… 15
15 Abdominal terga with long, erect pile, as long as or longer than scape; abdomen relatively short and broad (Figs 26, 27) ……………… ***C. arcuatum*** (Linnaeus)
– Abdominal terga with short, adpressed pile, some areas may look bare (Fig. 28) ……………………… 16
16 Scutellum entirely pale yellow (Fig. 28); anterior margin of wing yellowish-brown with apical dark macula …………………………… ***C. bactrianum*** Violovitsh
– Scutellum yellow with relatively small translucent, transparent macula in middle (Fig. 29); anterior margin of wing yellowish-brown without clear apical dark macula (Fig. 29) …………………………………… 17
17 Sterna: yellow fasciate maculae originated on posterolateral corner of sternum 2 do not join medially (Fig. 30) ………………………… ***C. lessonae*** Giglio Tos
– Sterna: yellow fasciate maculae originated on posterolateral corner of sternum 2 broadly joint medially forming fascia (Fig. 31) …… ***C. intermedium*** Meigen

Note: *C. intermedium* is a species complex (Speight 2016), and the current definition might include more than one species. Wings of some specimens have a dark brown apical macula.

DISCUSSION

Although more data is available to establish boundaries between biogeographic regions, climate change and human actions alter the ecosystems and their fauna. Moreover, researchers use certain geographical or political boundaries to delimit faunal or biogeographical regions with considerable controversy (Mengual 2012). Thompson (1999b) illustrates the biotic regional boundaries based on political subunits, although this was not accurate. One of the few countries across biogeographical boundaries is China. Huo et al. (2007) reported several specimens of *C. baphyrum* from Cili, Hunan province (29°25′47.7″ N 111°08′17.6″ E). Hunan province is considered Palaearctic by Thompson (1999b), thus our records would not be the first for the Palaearctic Region.

But other divisions exist, such as Holt et al. (2013), which includes Hunan province in their Sino-Japanese zoogeographic realm. On the other side, Hoffman (2001) mentions a transition zone between Palaearctic and Indomalayan Regions, which resembles the Sino-Japanese realm of Holt et al. (2013), and Hunan province is included in this transition zone. The western boundary between Palaearctic and Indomalayan regions has more agreement, and somehow divides north-south Pakistan. Based on all the available divisions, Iran can be considered Palaearctic, making our records the first specimens of *C. baphyrum* collected from West Palaearctic. On the other hand, the use of political or historical names in reference to regions or realms should not be encouraged, such as Asia (Gilasian et al. 2015).

The genus *Chrysotoxum* is distributed mainly in the Holarctic Region, with a few species reported from tropical areas (Thompson 2013) and probably found in higher altitudes (Shannon 1926). Iran is located in the Western Palearctic Region, with some influences from the Indomalayan Region in the south-east, and it has a rich fauna of insects, acting as a connection between the Palearctic and Indomalayan faunas. The Hormozgan province, where *C. baphyrum* was collected, and the whole southern part of Iran are poorly sampled and understudied. So far, no long sampling period and large-scale survey has been done in forests and cultivated lands of Iran. Thus, it would not be surprising to record more Indomalayan species in Iran, or even new species to science due to the location of Iran, between biodiversity hotspots such as Caucasus, Anatolian peninsula (as part of the Mediterranean Basin) and the mountains of Central Asia. More taxonomic studies and field work are needed in this country, and there is hope to pursue this goal in the next years as more and more Iranian researchers focus on Syrphidae.

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The snakes of Mali

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Abstract. From 2004 to 2010 we sampled snakes in different localities in the Republic of Mali, West Africa. A total of 5,224 snakes belonging to 60 species were collected at 37 localities, including specimens from 18 species not reported before from this country. Based on a full account of this collection, supplemented with additional museum specimens and reliable literature reports, we present an annotated checklist of the 65 snake species currently known from Mali. Collecting localities for all specimens are provided and, where necessary, some taxonomical and biogeographical issues are discussed.

Key words. Reptilia; Ophidia; biogeography; country checklist; venomous snakes; West Africa.

INTRODUCTION

The Republic of Mali is the second largest country of West Africa with 1,240,000 km^2 between latitudes 10°N and 25°N and longitudes 12°W and 4°E. The northern part of the country is Saharan (Fig. 1), the central part is Sahelian (Fig. 2), and the southern part is Sudanese or Sudano-Guinean (Figs 3–4). Elevation is low, ranging from 30 m along the banks of the Senegal River in the westernmost part of the country, to 1,155 m at the top of the highest peak in the Hombori Mounts in central Mali (Fig. 5). Even in the most elevated areas of the country, i.e. the Mandingue and Dogon Plateaux in south-eastern and central Mali, and the Adrar des Iforhas in northern Mali, elevation rarely exceeds 500 m. The country has a rich hydrological system, with the Niger River and its tributaries that form a large inner delta in central Mali before reaching the Sahara desert then heading southeast to the Gulf of Guinea, and with four main rivers in the upper Senegal River basin in the western part of the country (Arnaud & Pitte 2010).

Small collections of snakes from Mali, formerly Soudan français, have been reported by Pellegrin (1909), Chabanaud (1917), Angel (1922, 1933), de Witte (1930), Anderson (1935), Angel & Lhote (1938), Villiers (1950, 1951, 1952, 1953, 1954, 1956, 1965), Joger (1981), Schätti (1986), and Böhme et al. (1996). Papenfuss (1969) and Joger & Lambert (1996) reviewed the literature recording snake and other reptile species in Mali, reported their own collections, and provided a country checklist with locality records for each species. Specimens from Mali were included in works on certain genera or species, in particular by Roux-Estève (1974), Hughes (1976, 1977, 1983, 1985), Broadley (1984), Wüster & Broadley (2003), Trape & Mané (2006a), Trape et al. (2006, 2009, 2012), and Crochet et al. (2008). Trape & Mané (2006b) provided square-degree distribution maps for all species of snakes known from Mali and neighbouring countries, including a large part of the material here reported, but precise collecting localities were not mentioned. Sindaco et al. (2013) provided square-degree distribution maps of Palaearctic species distributed in northern Mali.

MATERIAL AND METHODS

From July 2002 to March 2010, we conducted field work in several regions of Mali in order to collect snakes. We deposited cans or buckets half filled with formaldehyde or ethanol in 32 villages (Fig. 6), which were housed by the chief of the village. We asked the villagers to deposit in these containers snakes they killed when they were occasionally encountered in the vicinity of their village. A modest award (300 CFA, i.e. approximately 0.6 US $) was given for each preserved specimen. In most parts of Mali, as in most parts of Africa, all species of snakes are feared and systematically killed when they are encountered. Thus, the objective of the award was to acknowledge the effort of carrying killed snakes from surrounding fields to the village, but without encouraging snake research and killing. Visits to the villages were organized in April 2003, January, June and December 2004, February, June and November 2005, January and May 2006, January, October and December 2007, January 2008, and March 2010, to retrieve the specimens. During these trips we also collected snakes at five additional localities. The 37 collecting localities (Table 1) were distributed either in the southern part of the country (7 localities between 11°00'N and 11°59'N), in the central part (13 localities between 12°00'N and 14°15'N) or in the northern part of the coun-

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Fig. 1. A typical sandy valley and wadi in the mountains of the Adrar des Iforas (19°01'N, 01°50'E).

Fig. 2. View of the Sahelian vegetation in western Mali, near Samé Ouolof study village (14°33'N, 11°20'W).

Fig. 3. Sudanese savanna in eastern Mali, west of Niamasso study village (13°02'N, 05°47'W).

try (17 localities between 14°16'N and 16°45'N), where average annual rainfall ranges approximatively from 1,000–1,100 mm, 500–1,000 mm, and 200–500 mm, respectively (Mahé et al. 2012). The most Saharan part of the country, i.e. north of 17°N, was not surveyed except during a two-week period in February 2004. Although no specimen was collected during these two weeks, some information on records of *Cerastes cerastes* Linnaeus, 1758 and *C. vipera* (Linnaeus, 1758) was obtained from locals (they are indicated as "sight record").

Most specimens were deposited at the Institut de Recherche pour le Développement (Dakar, Senegal; acronym: IRD) and several specimens were donated to the Museum national d'Histoire naturelle (Paris, France; acronym: MNHN). We also examined selected Malian specimens from the Institut Fondamental d'Afrique Noire (Dakar, Senegal; acronym: IFAN) and at the MNHN collections.

Specimens were identified to species according to classical identification keys for West African snakes (Villiers & Condamin 2005, Trape & Mané 2006b) and further taxonomic analysis (Trape et al. 2009, Trape et al. 2012, Trape et al., unpublished). For recent changes in snake generic names, we usually followed those adopted in the reptile database by Uetz et al. (2016) (http://www.reptile-database.org/).

RESULTS

We collected a total of 5,224 specimens belonging to 60 species (Table 1) and examined additional Malian specimens from IFAN (one specimen) and MNHN (13 specimens). Two additional species are known with certainty from Mali but were not represented among the specimens that we collected or examined personally. Altogether, the total number of snake species from Mali is 65. Coordinates of collecting localities are listed in Table 1, and those obtained from literature data and sight records are in Table 2.

Family Typhlopidae Gray, 1845

Afrotyphlops lineolatus (Jan, 1864)

Material: 12 specimens.

Localities: Npiébougou (11), Laminina (1).

Remarks: First record for Mali.

Afrotyphlops punctatus (Leach, 1819)

Material: 21 specimens.

Localities: Laminina (1), Mamoroubougou (7), Niamou (2), Npiébougou (1), Titiéna (4), Zamoko (6).

Literature record: Diafarabé (Villiers 1953).

Remarks: All specimens from Mamoroubougou and one

Table 1. Collecting localities of snakes in Mali (our study).

N	Locality	Latitude	Longitude	Altitude	Ecoregion	No. of specimens	No. of species
1	Agoudoud	15°54'N	01°13'W	320 m	Sahel	4	2
2	Ballabougou	12°52'N	06°52'W	338 m	Sudanese	15	7
3	Bamako	12°38'N	08°00'W	325 m	Sudanese	1	1
4	Bangaya	13°14'N	10°43'W	135 m	Sudanese	118	19
5	Boussouma	15°06'N	02°38'W	318 m	Sahel	19	4
6	Bouyanga	14°30'N	09°38'W	278 m	Sahel	305	12
7	Djinagué	12°59'N	09°52'W	305 m	Sudanese	125	17
8	Donguiba	13°49'N	06°05'W	303 m	Sudanese	1	1
9	Doro	16°08'N	00°50'W	295 m	Sahel	10	2
10	Doussoudiana	11°09'N	07'48'W	365 m	Sudano-Guinean	116	20
11	Gaoudel	15°59'N	04°05'W	270 m	Sahel	95	7
12	Gogui (10 km S)	15°35'N	09°20'W	210 m	Sahel	1	1
13	Gouina	14°00'N	11°06'W	70 m	Sudanese	1	1
14	Haoussa-Foulane	15°59'N	00°08'E	256 m	Sahel	7	4
15	Kinani	15°00'N	03°51'W	268 m	Sahel	37	5
16	Koundian	13°09'N	10°40'W	170 m	Sudanese	68	18
17	Koyretao	16°04'N	03°53'W	271m	Sahel	55	6
18	Laminina	11°12'N	07°46'W	361 m	Sudano-Guinean	160	28
19	Léré	15°43'N	04°54'N	268 m	Sahel	6	3
20	Mamoroubougou	11°14'N	05°28'W	386 m	Sudano-Guinean	1064	36
21	Niakoni	11°11'N	07°48'W	378 m	Sudano-Guinean	14	7
22	Niamasso	12°59'N	05°27'W	281 m	Sudanese	21	5
23	Niamou	14°01'N	08°02'W	372 m	Sudanese	498	23
24	Npiébougou	11°59'N	08°00'W	367 m	Sudano-Guinean	372	29
25	Sadjouroubougou	12°35'N	07°44'W	335 m	Sudanese	26	10
26	Samé Ouolof	14°29'N	11°34'W	41 m	Sahel	71	8
27	Saré-Soma	14°45'N	03°55'W	271 m	Sahel	31	4
28	Sébékourani	12°12'N	08°42'W	386 m	Sudanese	409	28
29	Séoulasso	13°14'N	04°42'W	279 m	Sudanese	292	16
30	Tacharane	16°09'N	00°04'E	257 m	Sahel	15	2
31	Ténintou	11°20'N	07°44'W	357 m	Sudano-Guinean	1	1
32	Tinjemban	16°44'N	02°50'W	269 m	Sahel	23	4
33	Titiéna	11°26'N	06°33'W	308 m	Sudano-Guinean	376	27
34	Topokhoné	15°02'N	10°34'W	105 m	Sahel	4	3
35	Toumboula	14°20'N	07°47'W	287 m	Sahel	170	9
36	Toya	16°39'N	03°03'W	266 m	Sahel	71	3
37	Zamoko	13°09'N	07°57'W	395 m	Sudanese	622	25
Total						**5,224**	**60**

specimen from Laminina and Titiéna were marbled, the rest were lineated with three of them blackish (all from Zamoko).

Family Leptotyphlopidae Stejneger, 1892

Myriopholis adleri (Hahn & Wallach, 1998)
Material: 1 specimen.
Locality: Sébékourani (1).
Remarks: First record for Mali.

Myriopholis albiventer (Hallermann & Rödel, 1995)
Material: 5 specimens.
Localities: Doussoudiana (1), Mamoroubougou (4).
Remarks: First record for Mali. A picture of the specimen from Doussoudiana was published in Trape & Mané (2006b).

Myriopholis algeriensis (Jacquet, 1895)
Material: no specimen studied.
Literature records: Bourem (Papenfuss 1969, as *Leptotyphlops macrorhynchus* (Jan, 1860); Hahn & Wallach 1998, as *Leptotyphlops macrorhynchus algeriensis*), Tombouctou (Broadley et al. 2014).

Myriopholis boueti (Chabanaud, 1917)
Material: 126 specimens.

Table 2. Coordinates of snake records from Mali (literature data and sight records). The asterisk means an approximate.

Locality	Latitude	Longitude
Adrar des Iforhas	18–20°N *	01–02°E *
Araouane	18°54'N	03°31'W
Bamako	12°39'N	08°00'W
Bandiagara	14°21'N *	03°37'W *
Bla	12°57'N	05°46'W
Bougouni	11°25'N	07°29'W
Bourasso	13°40'N	04°20'W
Bourem	16°57'N	00°21'W
Diafarabé	14°09'N	05°01'W
Didiéni (toward Kolokani)	13°42'N	08°02'W
Diré	16°16'N	03°24'W
Djenné	13°54'N	04°33'W
Dogo	15°10'N	04°26'W
Douentza	15°00'N	02°57'W
Fabiguine	16°44'N *	03°50'W *
Fatao (9 km N of)	14°24'N	09°29'W
Félou (falls)	14°21'N	11°21'W
Gao	16°16'N	00°03'W
Goundam	16°25'N	03°40'W
Gourao	15°19'N	04°02'W
Kakoulou	14°17'N	11°17'W
Kati	12°43'N	08°04'W
Katibougou	12°30'N	08°05'W
Kayo	13°53'N	05°37'W
Ké-Macina	13°58'N	05°23'W
Kidal	18°26'N	01°24'E
Kita	13°03'N	09°29'W
Kokounkourou	12°58'N	09°37'W
Lobi	16°15'N	00°04'W *
Madina-Kagoro (10 km W of)	14°20'N	07°45'W
Mopti and vicinity	14°30'N	04°12'W
Mourdiah	14°28'N	07°28'W
Naréna	12°14'N	08°38'W
Niamiga (W of)	14°30'N	11°12'W
Nioro du Sahel	15°14'N	09°35'W
Négala (toward Kassaro)	12°55'N	08°40'W
San	13°18'N	04°54'W
Saré Malé	14°05'N	04°26'W
Sévaré (158 km SW of)	13°40'N	04°20'W
Sikasso (toward Sindi)	11°30'N	05°56'W
Sormé	14°52'N	04°25'W
Tabakoro	11°26'N	06°46'W
Taga Diabozo	14°18'N	04°57'W
Takabart (SW)	20°10'N *	01°10'W *
Taoudeni (half way to Araouane)	20°40'N *	03°50'W *
Tessalit (and vicinity)	20°12'N	01°00'W
Tilembaya	14°09'N	04°59'W
Timétrine	19°20'N	00°42'W
Tisserlitine (toward Timétrine)	20°36'N	00°11'W
Toguéré Sanga	14°28'N	03°19'W
Tombouctou	16°46'N	03°01'W
Wana Boubou	14°01'N	04°58'W
Yélimané	15°08'N	10°34'W

Fig. 4. Sudano-Guinean savanna in the vicinity of Doussoudiana, the southernmost village of the study (11°11'N, 07°44'W).

Fig. 5. The Hombori Mounts, the highest mountains of Mali (15°14'N, 01°48'W).

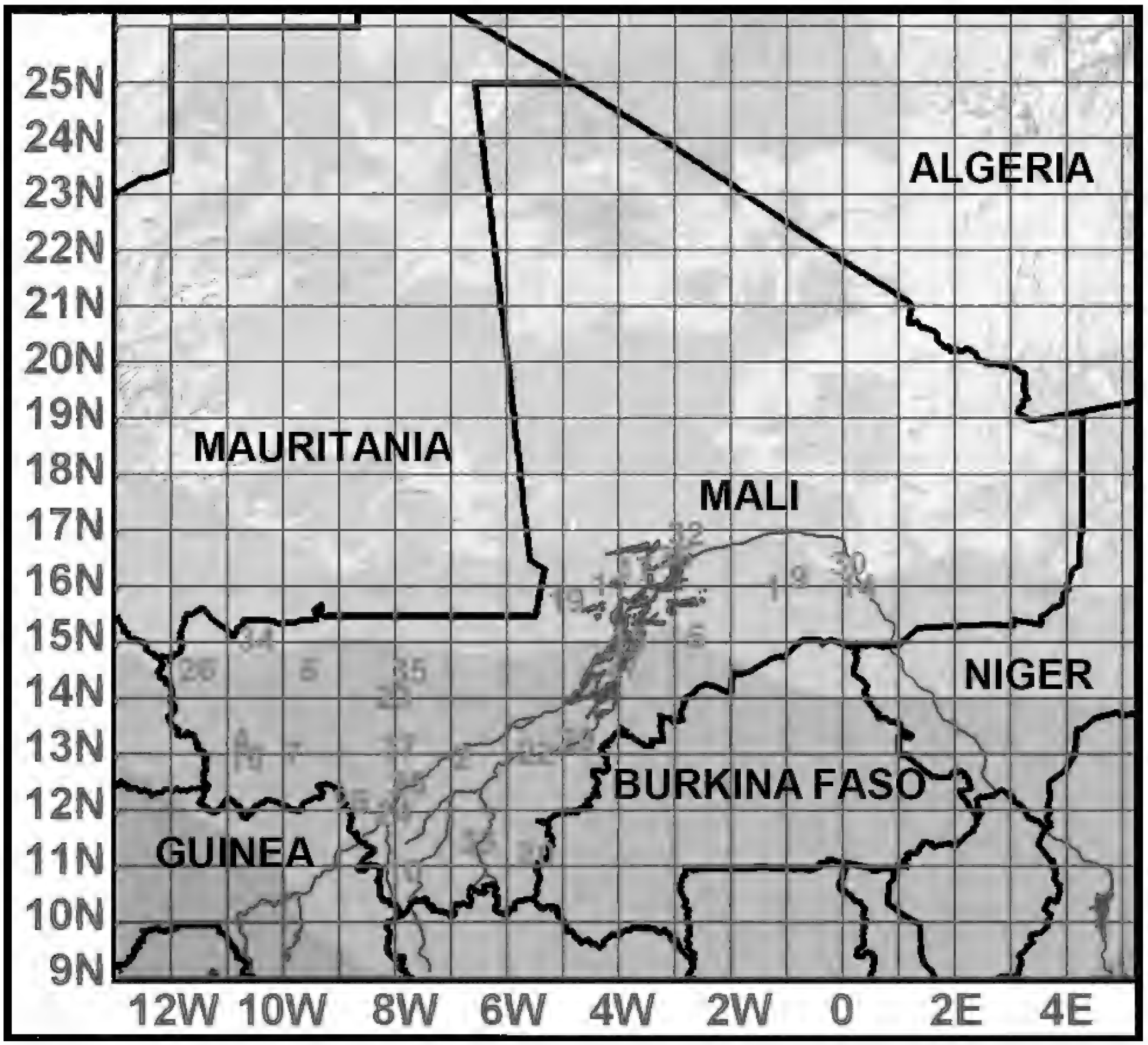

Fig. 6. Map of Mali with location of villages selected for the study. See Table 1 for locality numbers. Doussoudiana, Laminina and Niakoni villages, located within a 5 km radius, are represented by a single number (n° 10). Colours for vegetation areas: Guinean: dark green; Sudanese: green; Sahelian: light green; Saharan: yellow for sandy areas, white for stony areas, grey for rocky and mountainous areas.

Localities: Bamako (1), Bouyanga (9), Djinagué (2), Koundian (1), Niamou (1), Npiébougou (27), Samé Ouolof (1), Sébékourani (10), Zamoko (74).

Literature records: Djenné (Chabanaud 1917, type locality), Bamako (Villiers 1950).

Remarks: One specimen from Sébékourani was attributed erroneously to *Myriopholis rouxestevae* (Trape & Mané, 2004) in the distribution map of Trape & Mané (2006b).

Rhinoguinea magna Trape, 2014

Material: 16 specimens.

Locality: Mamoroubougou (16).

Remarks: This species is currently known only from Mamoroubougou, the type locality, where it represented 1.5% of the 1,042 fossorial reptiles collected in this locality (Typhlopidae: 7 specimens, Leptotyphlopidae: 731 specimens, Amphisbaenidae (*Cynisca leucura* (Duméril & Bibron, 1839)): 304 specimens).

Rhinoleptus koniagui (Villiers, 1956)

Material: 11 specimens.

Localities: Djinagué (1), Koundian (1), Laminina (3), Npiébougou (6).

Remarks: First record for Mali. Koundian and Laminina

Fig. 7. The Farako River and its forest gallery near Mamorouboungou, the village where the highest number of snakes and snake species were collected (11°14'N, 05°28'W).

Fig. 8. The Sudanese savanna between Koundian and Bangaya villages in southwestern Mali (13°10'N, 10°38'W).

Fig. 9. The Sudanese savanna near Sébékourani village where 28 snake species were collected (12°02'N, 08°44'W). The deadly carpet viper *Echis jogeri* was abundant.

specimens were reported on a grid map in Trape & Mané (2006b), where the square degree 11°N/5°W was mentioned erroneously.

Tricheilostoma bicolor (Jan, 1860)
Material: 838 specimens.
Localities: Doussoudiana (4), Laminina (1), Mamoroubougou (711), Niamou (3), Npiébougou (7), Sébékourani (9), Titiéna (2), Zamoko (101).
Literature records: Diafarabé (Villiers 1950), Bamako (Villiers 1950, as *Leptotyphlops brevicauda* (Bocage, 1887)).
Remarks: The maximum total length was 191 mm (tail length: 6 mm) in a specimen from Mamoroubougou (IRD 4289.M), a record for the species. Smallest specimens from Mamoroubougou were 9–10 cm long.

Family Boidae Gray, 1825

Eryx muelleri (Boulenger, 1892)
Material: 174 specimens.
Localities: Bangaya (1), Bouyanga (42), Doro (7), Gaoudel (7), Haoussa-Foulane (1), Koundian (2), Koyretao (8), Léré (3), Niamasso (1), Niamou (95), Samé Ouolof (1), Séoulasso (1), Tinjemban (1), Toumboula (4).
Literature records: Bandiagara (Angel 1933), Gao (Angel & Lhote 1938), Nioro du Sahel (Villiers 1950), Dogo (Villiers 1956), Mourdiah (Joger & Lambert 1996).

Family Pythonidae Fitzinger, 1826

Python regius (Shaw, 1802)
Material: 55 specimens.
Localities: Ballabougou (1), Djinagué (3), Doussoudiana (10), Koundian (1), Laminina (7), Niakoni (1), Niamou (1), Sadjouroubougou (1), Sébékourani (18), Titiéna (8), Zamoko (4).
Literature record: Southern Mali (Chippaux 1999).

Python sebae (Gmelin, 1788)
Material: 23 specimens.
Localities: Bangaya (1), Boussouma (1), Bouyanga (1), Djinagué (1), Laminina (3), Niamou (5), Npiébougou (1), Samé Ouolof (1), Sébékourani (7), Titiéna (1), Toumboula (1).
Literature records: Kati (Angel 1922), Sikasso (Villiers 1965), Bamako (Broadley 1984), Bandiagara (Böhme et al. 1996).

Family Colubridae Oppel, 1811

Afronatrix anoscopus (Cope, 1861)
Material: 17 specimens.
Localities: Mamoroubougou (16), Titiéna (1).
Remarks: First record for Mali. Mamoroubougou record was reported on a grid map in Trape & Mané (2006b).

Fig. 10. Near Bandiagara cliff, an area of transition between the Sudanese savanna and the Sahel (14°02'N, 03°46'W).

Bamanophis dorri (Lataste, 1888)
Material: 37 specimens.
Localities: Bangaya (24), Koundian (4), Niamou (8), Toumboula (1).
Literature records: Kati (Angel 1922), Bamako (Villiers 1956, Joger & Lambert 1996), chutes du Félou, between Négala and Kassaro (Joger 1981), Bandiagara (Joger & Lambert 1996).
Remarks: Most specimens where included in the description of the genus *Bamanophis* by Schätti & Trape (2008).

Crotaphopeltis hippocrepis (Reinhardt, 1843)
Material: 3 specimens.
Localities: Doussoudiana (1), Mamoroubougou (1), Npiébougou (1).
Remarks: First record for Mali. This species seems rare in Mali contrary to Burkina Faso and Guinea, two neighbouring countries where *C. hippocrepis* is both common and widely distributed (Roman 1974, Trape & Baldé 2014).

Crotaphopeltis hotamboeia (Laurenti, 1768)
Material: 225 specimens.
Localities: Ballabougou (1), Bangaya (26), Djinagué (29), Doussoudiana (12), Laminina (10), Mamoroubougou (25), Niakoni (2), Niamasso (2), Niamou (8), Npiébougou (11), Sadjouroubougou (2), Saré-Soma (2), Sébékourani (58), Séoulasso (1), Titiéna (22), Toumboula (5), Zamoko (9).
Literature record: Diafarabé (Villiers 1952).

Dasypeltis confusa Trape & Mané, 2006
Material: 3 specimens.
Locality: Diafarabé (1, coll. IFAN), Mamoroubougou (2).
Remarks: The Diafarabé specimen was collected in the early 1950's by the French ichthyologist J. Daget and was first published as *Dasypeltis scabra* (Linnaeus, 1758) by Villiers (1953). In fact, its pattern (5L) is typical of *D. confusa* (see Trape & Mané 2006a and Trape et al. 2012), and there is no doubt that it belongs to this Guinean species although Diafarabé is located in the Sahel at 320 km north of the nearest known locality (Mamoroubougou). Since Diafarabé is riverine of the Niger River and only *D. sahelensis* Trape & Mané, 2006 is known in the area, we presume that this specimen was carried by floods, as it also probably occurred for the holotype of *Echis jogeri* Cherlin, 1990 from Tombouctou.

Dasypeltis gansi Trape & Mané, 2006
Material: 3 specimens.
Localities: Ballabougou (2), Séoulasso (1).
Remarks: The other records presented on the grid map in Trape & Mané (2006b) are referable to *D. latericia* Trape & Mané, 2006 (see below).

Fig. 11. A view of the Sahelian landscape in the vicinity of Boussouma study village (15°08'N, 02°31'W). *Psammophis* aff. *sibilans*, *Naja nigricollis* and *Echis leucogaster* were the most abundant species, but *Python sebae* was also collected in a pound.

Dasypeltis latericia Trape & Mané, 2006
Material: 25 specimens.
Localities: Bangaya (4), Koundian (1), Niamou (5), Npiébougou (2), Sébékourani (1), Séoulasso (4), Titiéna (1), Zamoko (7).
Remarks: Most specimens were included in the description of *D. latericia* (Trape & Mané 2006a). *Dasypeltis latericia* was recently given full species rank following a molecular analysis of the genus *Dasypeltis* (Trape et al. 2012).

Dasypeltis sahelensis Trape & Mané, 2006
Material: 23 specimens.
Localities: Bouyanga (5), Gaoudel (5), Koyretao (8), Séoulasso (2), Toumboula (3).
Remarks: Several specimens were included in the material used for the description of this species (Trape & Mané 2006a). All specimens from the type series have an entire nasal and this character was used in the key of the genus *Dasypeltis* (Trape et al. 2012). However, we recently observed a semi-divided nasal in some specimens of *D. sahelensis* from Morocco.

Dispholidus typus (Smith, 1829)
Material: 19 specimens.
Localities: Doussoudiana (1), Laminina (5), Mamoroubougou (7), Npiébougou (2), Titiéna (1), Zamoko (3).
Literature record: Sikasso (Villiers 1965).

Grayia smithi (Leach, 1818)
Material: 15 specimens.
Locality: Mamoroubougou (15).
Remarks: First record for Mali.

Meizodon coronatus (Schlegel, 1837)
Material: 21 specimens.
Localities: Bangaya (1), Bouyanga (1), Mamoroubougou (1), Sébékourani (12), Titiéna (6).
Literature records: Kati (Angel 1922), Tilembaya (Villiers 1951), Diafarabé (Villiers 1952), Wana Boubou (Villiers 1953).

Natriciteres olivacea (Peters, 1854)
Material: 1 specimen (coll. MNHN).
Locality: Gao.
Literature record: Gao (Chabanaud 1917).

Philothamnus irregularis (Leach, 1819)
Material: 42 specimens.
Localities: Doussoudiana (9), Laminina (15), Niakoni (1), Npiébougou (5), Sébékourani (8), Titiéna (4).
Literature records: Kati (Angel 1922, as *Chlorophis emini* (Günther, 1888)), Kayo (Villiers 1950, as *Philothamnus nitidus* (Günther, 1863)), Diafarabé, Tilembaya (Villiers 1953), Ké-Macina (Villiers 1956), Sikasso (Villiers 1965), Lobi near Gao (Hughes 1983, 1985), Mourdiah (Joger & Lambert 1996).

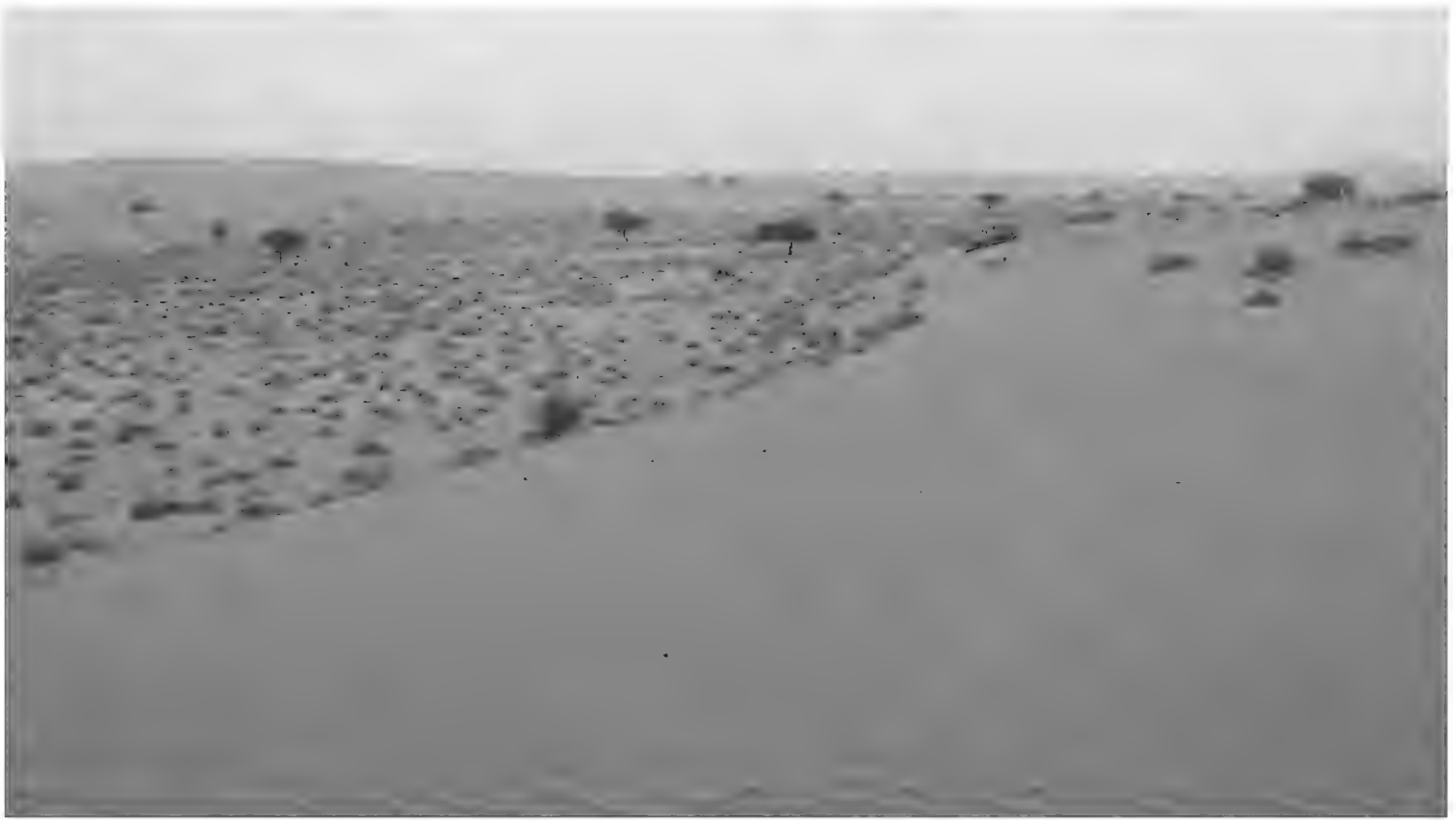

Fig. 12. Vicinity of Haoussa Foulane village (16°00'N, 00°08'W), an area of Sahelo-Saharan transition where *Echis leucogaster*, *Eryx muelleri*, *Psammophis* aff. *sibilans* and *Rhagerhis moilensis* were collected.

Philothamnus semivariegatus smithi Bocage, 1882
Material: 4 specimens.
Localities: Doussoudiana (2), Laminina (1), Niamou (1).
Literature records: Bandiagara (Angel 1933), Gao (Hughes 1985).
Remarks: Trape & Mané (2006b) attributed West African populations of *P. semivariegatus* to a distinct subspecies, i.e. *P. semivariegatus* ssp., differing from the nominal subspecies by its dorsal colouration: almost uniformly green in West Africa, versus green with black crossbars in southern Africa where the type originates. Trape & Baldé (2014) revalidated *Philothamnus semivariegatus smithi* Bocage, 1882 for this subspecies. Preliminary molecular studies (Trape & Mediannikov, unpublished) suggest that full specific rank may be justified.

Spalerosophis diadema cliffordi (Schlegel, 1837)
Material: 8 specimens.
Localities: Gaoudel (2), Koyretao (5), Toya (1).
Literature record: Goundam (Angel 1933).

Telescopus tripolitanus (Werner, 1909)
Material: 8 specimens.
Localities: Kinani (3), Toumboula (5),
Literature records: Kidal (Andersson 1935, as *Tarbophis obtusus* (Reuss, 1834)), Mourdiah (Joger & Lambert 1996).
Remarks: Several specimens where included in the revision of this species by Crochet et al. (2008).

Telescopus variegatus (Reinhardt, 1843)
Material: 8 specimens.
Localities: Koundian (1), Mamoroubougou (2), Zamoko (5).
Literature record: Kati (Angel 1922).

Family Lamprophiidae Ritzinger, 1843

Amblyodipsas unicolor (Reinhardt, 1843)
Material: 5 specimens.
Localities: Mamoroubougou (5).
Remarks: This record, the only one for Mali, appeared on a grid map without specific documentation in Trape & Mané (2006b).

Atractaspis aterrima Günther, 1863
Material: 5 specimens.
Localities: Doussoudiana (2), Laminina (1), Mamoroubougou (1), Sadjouroubougou (1).
Literature record: Bougouni (Schätti 1986).

Atractaspis dahomeyensis Barboza du Bocage, 1887
Material: 10 specimens.
Localities: Mamoroubougou (7), Npiébougou (2), Titiéna (1).
Literature record: Tabakoro (Schätti 1986).

Atractaspis micropholis Günther, 1872
Material: 1 specimen.
Locality: Niamou (1).
Literature record: (?) Madina Kagoro (Joger & Lambert 1996, specimen possibly attributable to *Atractaspis watsoni* Boulenger, 1908).

Atractaspis watsoni Boulenger, 1908
Material: 7 specimens.
Localities: Bandiagara (1, coll. MNHN), Diafarabé (1, coll. MNHN), Douentza (1, coll. MNHN), Samé Oulof (1), Séoulasso (1), Topokhoné (2).
Literature records: Bandiagara (Angel 1933), Douentza (Angel & Lhote 1938).
Remarks: This species was resurrected from the synonymy of *Atractaspis microlepidota* (Günther, 1866) by Trape et al. (2006), who also reviewed previous records of *Atractaspis micropholis* Günther, 1872 and provided keys to distinguish the three species. *Atractaspis microlepida* may occur in Mali but this West African species is currently known only from Senegal, The Gambia and southern Mauritania.

Boaedon fuliginosus (Boie, 1827)
Material: 92 specimens.
Localities: Bangaya (3), Bouyanga (1), Djinagué (7), Doussoudiana (4), Kinani (2), Koundian (5), Laminina (8), Mamoroubougou (16), Niamou (2), Npiébougou (11), Sébékourani (20), Séoulasso (2), Titiéna (2), Zamoko (9).
Literature record: Diafarabé (Villiers 1951).

Boaedon lineatus Duméril, Bibron & Duméril, 1854
Material: 70 specimens.
Localities: Bangaya (3), Djinagué (8), Doussoudiana (1), Koundian (4), Laminina (2), Mamoroubougou (12), Npiébougou (5), Sadjouroubougou (1), Sébékourani (15), Séoulasso (2), Titiéna (11), Zamoko (6).
Literature records: Kati (Angel 1922), Naréna (Schätti 1986).

Gonionotophis granti (Günther, 1863)
Material: 4 specimens.
Localities: Laminina (1), Mamorougougou (1), Npiébougou (1), Sébékourani (1).
Remarks: First record for Mali.

Lycophidion albomaculatum Steindachner, 1870
Material: 33 specimens.
Localities: Djinagué (5), Koundian (3), Niamou (3), Sébékourani (16), Zamoko (6).
Literature records: Yélimané, Bamako (Condamin 1994).

Lycophidion irroratum (Leach, 1819)
Material: 5 specimens.
Localities: Mamoroubougou (5).
Remarks: First record for Mali.

Lycophidion semicinctum (Duméril, Bibron & Duméril, 1854)
Material: 24 specimens.
Localities: Laminina (4), Mamoroubougou (8), Npiébougou (9), Titiéna (3).
Literature record: Sikasso (Joger & Lambert 1996).

Mehelya crossi (Boulenger, 1895)
Material: 33 specimens.
Localities: Laminina (2), Mamoroubougou (10), Npiébougou (3), Sadjouroubougou (1), Sébékourani (4), Titiéna (11), Zamoko (2).
Literature record: Sikasso (Villiers 1965).
Remarks: Four specimens from three localities (Mamoroubougou, Npiébougou and Sébékourani) have 19 ranks of dorsals at midbody instead of 17. All other characteristics are typical of *Mehelya crossi*. We also observed 19 rows of dorsals in a specimen from Kissidougou (Guinea), which was molecularly similar to a typical *M. crossi* (K Tolley and JF Trape, unpublished), suggesting that *Mehelya riggenbachi* (Sternfeld, 1910) is a junior synonym of *M. crossi* as previously mentioned by Broadley (2007). The generic status of *M. crossi* is currently under review (Broadley et al., submitted for publication).

Polemon neuwiedi (Jan, 1858)
Material: 3 specimens.
Locality: Mamoroubougou (3).
Remarks: First record for Mali.

Prosymna collaris (Sternfeld, 1908)
Material: 1 specimen.
Locality: Topokhoné (1).
Literature records: Yélimané (Broadley 1980, as *Prosymna meleagris greigerti* Mocquard, 1906; Chirio et al. 2011, as *Prosymna greigerti collaris* Sternfeld, 1908), (?) Bamako (Broadley 1980, as *Prosymna meleagris greigerti*; Chirio et al. 2011, as *Prosymna greigerti collaris*; MNHN specimen probably mislabelled).
Remarks: This Sahelian species with a white collar differs molecularly both from *Prosymna greigerti* Mocquard, 1906 and from *Prosymna meleagris* (Reinhardt, 1843), but was provisionally treated as a subspecies of *P. greigerti* by Chirio et al. (2011). We recently collected sympatric specimens of the two taxa in Chad, where no trace of intergradation was observed, and a similar situation was observed in northern Cameroon. For this reason we prefer to treat this taxon as separate species as it is easy to distinguish by its colour pattern.

Prosymna greigerti Mocquard, 1906
Material: 48 specimens.
Localities: Bangaya (1), Djinagué (1), Koundian (1),

Laminina (6), Mamoroubougou (15), Niamou (1), Npiébougou (7), Sébékourani (7), Titiéna (6), Toumboula (1), Zamoko (2).
Literature records: Soudan français (Chabanaud 1916, as *Prosymna meleagris*), Kati (Angel 1922), San (Angel & Lhote 1938), Bamako (Broadley 1980).
Remarks: Most specimens were included in the recent revision of *Prosymna greigerti* and *Prosymna meleagris* (Chirio et al. 2011).

Psammophis elegans (Shaw, 1802)
Material: 91 specimens.
Localities: Bangaya (1), Bouyanga (1), Doussoudiana (6), Kinani (5), Koundian (8), Laminina (8), Mamoroubougou (7), Npiébougou (15), Sadjouroubougou (4), Samé Ouolof (2), Saré-Soma (1), Sébékourani (6), Séoulasso (14), Ténintou (1), Titiéna (3), Zamoko (9).
Literature records: Kati (Angel 1922, as *Psammophis schokari* Forsskål, 1775), Diré, Bandiagara (Angel 1933), Dogo (Villiers 1953), Kita (Joger 1981), Mourdiah (Joger & Lambert 1996).

Psammophis lineatus (Duméril, Bibron & Duméril, 1854)
Material: 2 specimens.
Locality: Mamoroubougou (2).
Literature record: Kati (Angel 1922).

Psammophis phillipsi (Hallowell, 1844)
Material: 1 specimen.
Locality: Laminina (1).
Remarks: First record for Mali. This specimen with 17 dorsals, 180 ventrals and 102 subcaudals is dorsally uniform with black spots on the supralabials, four infralabials in contact with the first pair of mentals, and an entire anal scale.

Psammophis praeornatus (Schlegel, 1837)
Material: 28 specimens.
Localities: Mamoroubougou (2), Niamou (1), Npiébougou (1), Sadjouroubougou (1), Samé Ouolof (1), Sébékourani (1), Séoulasso (7), Titiéna (6), Zamoko (8).
Literature records: Toguéré Sanga (Villiers 1956), Sikasso (Villiers 1965).

Psammophis schokari Forsskål, 1775
Material: 4 specimens.
Localities: Gaoudel (1), Tinjemban (3).
Literature record: Tombouctou (Chabanaud 1917).
Remarks: Loveridge (1940) erroneously attributed Chabanaud's specimen to *Psammophis elegans*. None of our specimens has the high ventral count (185 and higher) of *Psammophis aegyptius* Marx, 1958.

Psammophis aff. *sibilans* (Linnaeus, 1758)
Material: 722 specimens.
Localities: Agoudoud (2), Ballabougou (5), Bangaya (18), Boussouma (13), Bouyanga (36), Djinagué (27), Donguiba (1), Doussoudiana (13), Gaoudel (31), Haoussa-Foulane (2), Kinani (17), Koundian (15), Koyretao (2), Laminina (14), Léré (2), Mamoroubougou (13), Niakoni (3), Niamasso (16), Niamou (80), Npiébougou (23), Samé Ouolof (43), Saré-Soma (27), Sébékourani (57), Séoulasso (82), Tacharane (4), Tinjemban (3), Titiéna (46), Toumboula (5), Toya (66), Zamoko (56).
Literature records: Kati (Angel 1922), Bandiagara (Angel 1933, Papenfuss 1969), Diafarabé, Gourao (Villiers 1950), Mopti (Angel & Lhote 1938), Bamako (Villiers 1956), Sikasso (Villiers 1965), Kakoulou (Joger 1981), between Ségou and Séwaré, 158 km SW Séwaré, between Séwaré and Mopti, Djenné, Bla, Bandiagara (Böhme et al. 1996), Lac Fabiguine, between Sikasso and Sinndi (Joger & Lambert 1996).
Remarks: The status of West African specimens of the *Psammophis sibilans* complex is currently under review (Trape et al., in preparation). These specimens from Mali are characterized by five infralabials in contact with the first pair of mentals, a divided anal, and a more-or-less striped dorsal pattern, with at least a black and white chain on the scales of the vertebral line.

Rhagerhis moilensis (Reuss, 1834)
Material: 8 specimens.
Localities: Gaoudel (5), Gogui (1), Haoussa-Foulane (1), Koyretao (1).
Literature record: Adrar des Iforhas (Angel & Lhote 1938).

Rhamphiophis oxyrhynchus (Reinhardt, 1843)
Material: 97 specimens.
Localities: Bangaya (1), Bouyanga (4), Djinagué (1), Doussoudiana (6), Laminina (3), Mamoroubougou (3), Niakoni (2), Niamou (3), Npiébougou (16), Sébékourani (9), Séoulasso (12), Titiéna (28), Zamoko (9).
Literature records: Kati (Angel 1922), Diafarabé (Villiers 1951), Kita (Joger 1981).

Family Elapidae Boie, 1827

Elapsoidea semiannulata moebiusi (Werner, 1897)
Material: 28 specimens.
Localities: Bangaya (1), Djinagué (1), Doussoudiana (2), Laminina (1), Mamoroubougou (1), Npiébougou (13), Sébékourani (2), Zamoko (7).
Literature record: southern Mali (Chippaux 1999).

Naja haje (Linnaeus, 1758)
Material: 2 specimens (NMZB and ZMUC collections).
Locality: Tombouctou (2).

Literature record: Tombouctou (Hughes 1983).
Remarks: These two museum specimens were examined by D.G. Broadley as part of a review of the *Naja haje* complex in West Africa (Trape et al. 2009). They belong to *Naja haje* contrary to other reports of this species in Mali, which are attributable to *Naja senegalensis* Trape, Chirio & Wüster, 2009 (see Trape et al. 2009 and below).

Naja katiensis Angel, 1922
Material: 356 specimens.
Localities: Ballabougou (1), Djinagué (4), Doussoudiana (8), Laminina (14), Mamoroubougou (53), Npiébougou (106), Sadjouroubougou (5), Sébékourani (8), Titiéna (69), Zamoko (88).
Literature records: Kati (Angel 1922, type locality), Kokounkourou, Naréna, Bougouni (Schätti 1986).

Naja cf. *melanoleuca* Hallowell, 1857
Material: 12 specimens.
Localities: Bangaya (1), Laminina (1), Mamoroubougou (3), Npiébougou (4), Sébékourani (1), Titiéna (2).
Literature records: Kati (Angel 1922), Kokounkourou (Schätti 1986).
Remarks: Our specimens have the banded pattern typical of the West African savanna form of the *Naja melanoleuca* complex.

Naja nigricollis Reinhardt, 1843
Material: 40 specimens.
Localities: Bangaya (7), Boussouma (3), Koundian (6), Mamoroubougou (2), Niamasso (1), Niamou (4), Sébékourani (6), Séoulasso (2), Toya (4), Zamoko (5).
Literature records: Kati (Angel 1922, Villiers 1951), Sikasso (Villiers 1965).

Naja senegalensis Trape, Chirio & Wüster, 2009
Material: 33 specimens.
Localities: Ballabougou (2), Bangaya (1), Djinagué (2), Doussoudiana (1), Koundian (1), Laminina (2), Mamoroubougou (3), Npiébougou (2), Sadjouroubougou (1), Saré-Soma (1), Sébékourani (2), Titiéna (10), Zamoko (5).
Literature records: chutes du Félou, Mourdiah, Didieni (Joger & Lambert 1996, as *Naja haje*).
Remarks: Our specimens were included in the description of this species that was previously confounded with *N. haje*. *Naja senegalensis* is currently known from Senegal, Gambia, Guinea, Guinea Bissau, Ivory Coast, Ghana, Mali, Burkina Faso, Niger, Benin and Nigeria (Trape et al. 2009, Trape & Baldé 2014). In Mali, it appears distributed in the whole country except in Sahelo-Saharan areas where the occurrence of *N. haje* in Tombouctou was confirmed (Trape et al. 2009).

Family Viperidae Oppel, 1811

Bitis arietans (Merrem, 1820)
Material: 79 specimens.
Localities: Bangaya (9), Bouyanga (3), Djinagué (2), Doussoudiana (5), Chutes de Gouina (1), Koundian (2), Laminina (8), Mamoroubougou (5), Niakoni (1), Niamasso (1), Niamou (5), Npiébougou (13), Sébékourani (10), Titiéna (12), Zamoko (2).
Literature records: Katibougou, Sormé (Villiers 1950), Sévaré (Papenfuss 1969), Kokounkourou (Schätti 1986), between Bla and Bandiagara, Bla (Böhme et al. 1996).

Causus maculatus (Hallowell, 1842)
Material: 187 specimens.
Localities: Bangaya (11), Djinagué (10), Doussoudiana (12), Koundian (8), Laminina (11), Mamoroubougou (15), Niamou (1), Npiébougou (7), Sébékourani (21), Titiéna (36), Zamoko (55).
Literature records: Kati (Angel 1922, Villiers 1951, as *Causus rhombeatus* (Lichtenstein, 1823)), Saré Malé (Villiers 1950, as *C. rhombeatus*), Taga Diabozo (Villiers 1952, as *C. rhombeatus*), Dogo (Villiers 1953, as *C. rhombeatus*), Bamako (Villiers 1956, as *C. rhombeatus*), Sikasso (Villiers 1965, as *C. rhombeatus*), Naréna, Bougouni (Schätti 1986), see also map of Hughes (1977).

Cerastes cerastes (Linnaeus, 1758)
Material: 2 specimens (coll. MNHN).
Localities: 50 km N of Kidal, rocher d'Eguerer.
Literature and sight records: Timétrine (de Witte 1930), Tessalit (Joger & Lambert 1996), SW of Adrar Takabart (sight record).

Cerastes vipera (Linnaeus, 1758)
Material: 1 specimen (coll. MNHN).
Locality: Between Tisserlitine and Timétrine.
Literature and sight records: Between Tisserlitine and Timétrine (de Witte 1930), vicinity of Araouane, half way between Araouane and Taoudeni, Tessalit (sight records).

Echis leucogaster Roman, 1972
Material: 523 specimens.
Localities: Agoudoud (2), Boussouma (2), Bouyanga (188), Doro (3), Gaoudel (44), Haoussa-Foulane (3), Kinani (10), Koyretao (31), Léré (1), Niamou (43), Samé Ouolof (21), Séoulasso (2), Tacharane (11), Tinjemban (16), Topokhoné (1), Toumboula (145).
Literature records: Bandiagara (Angel 1933, as *Echis carinatus* (Schneider, 1801)), Kidal (Andersson 1935, as *Echis carinatus*), Adrar des Iforhas (Angel & Lhote 1938, as *Echis carinatus*), Mopti, Mourdiah (Joger & Lambert 1996), Séoulasso (Pook et al. 2009).
Remarks: Most specimens have a clear venter, but specimens with a spotted venter, at least on each side of the

ventrals, were not rare, particularly in western Mali. All specimens had high scale counts, typical of *E. leucogaster* (ventrals: 158–177 in males, 166–189 in females; subcaudals 30–40 in males, 27–35 in females).

Echis ocellatus Stemmler, 1970
Echis jogeri Cherlin, 1990

Material: 933 specimens.

Localities: Ballabougou (3), Bangaya (4), Bouyanga (14), Djinagué (21), Doussoudiana (16), Koundian (4), Laminina (26), Mamoroubougou (65), Niakoni (4), Niamou (225), Npiébougou (60), Sadjouroubougou (9), Sébékourani (99), Séoulasso (159), Titiéna (80), Zamoko (144).

Literature record: Bandiagara (Angel 1933, as *Echis carinatus*), Kati (Villiers 1951, as *Echis carinatus,* Hughes 1976), Bamako (Villiers 1952, 1956, as *Echis carinatus*), Kita (Villiers 1953 as *Echis carinatus*), between Negala and Kassaro, W of Kita, W of Niamiga (Joger 1981, as *Echis* sp.; Joger & Lambert 1996, as *Echis jogeri*), Tombouctou (Cherlin 1990, type locality of *Echis jogeri*), Niakoni (Pook et al. 2009).

Remark: Cherlin (1990) described *Echis jogeri* on the basis of a clear venter and a much lower ventral count than *Echis ocellatus*. The type of *E. jogeri* is a female with 132 ventrals (123 ventrals were erroneously mentioned by Cherlin), and such low counts are also observed in Senegal (121–135 in males, 128–143 in females) and northwestern Guinea (127–132 in males, 131–138 in females) (Trape & Mané 2004, Trape & Baldé 2014). By contrast, the type of *Echis ocellatus* from Garango (Burkina Faso) is a female with 156 ventrals. In this country, ventral counts of *Echis ocellatus* range from 134 to 152 in males and from 140 to 157 in females (Roman 1972, 1976). Pook et al. (2009) demonstrated that specimens from Senegal are molecularly divergent from those of other parts of Africa and hence confirmed that *E. jogeri* is a valid species.

In order to separate *E. jogeri* from *E. ocellatus* in our study, we investigated a sample of 274 specimens from the different localities where we obtained specimens of this complex. Based on our data from Senegal (all specimens from this country have low ventral counts and are thus presumed to belong to *E. jogeri*) and Roman's data from Burkina Faso (most of them are presumed to belong to *E. ocellatus* since there is very little overlap in ventral counts with Senegalese specimens), we attributed to *E. jogeri* specimens with 121–133 (males) or 128–139 (females) ventrals, and to *E. ocellatus* specimens with 136–152 (males) or 144–157 (females) ventrals. Males with 134–135 ventrals and females with 140–143 ventrals were classified as *incertae sedis*. Table 3 shows that most specimens from southwestern Mali (Bangaya, Djinagué, Koundian, Sébékourani) can be attributed to *E. jogeri*, and most specimens from central-western (Bouyanga) and south-eastern Mali (Ballabougou, Doussoudiana, Laminina, Mamoroubougou, Niakoni, Npiébougou, Sadjouroubougou, Séoulasso, Titiéna) to *E. ocellatus*. Both species are present in south-central Mali where the proportion of specimens *incertae sedis* was much higher than expected (e.g. Niamou, Zamoko), suggesting that hybrids may occur and/or that the range of ventral counts for one or both the two species differs between Mali and its neighbouring countries. The presence of absence of black spots

Table 3. Number of specimens attributable to *Echis jogeri* or *Echis ocellatus* based on the number of ventral scales. *E. jogeri*: 121–133 (males) or 128–139 (females); *E. ocellatus* 136–152 (males) or 144–157 (females); incertae sedis: 134–135 (males) or 140–143 (females). Only specimens with intact body and tail allowing full ventral and subcaudal counts were selected for the study.

Locality (N° specimens)	N° studied specimens	N° of *E. jogeri*	N° of *E. ocellatus*	N° of *incertae sedis*
Bangaya (4)	3	2	0	1
Djinagué (21)	18	15	0	3
Koundian (4)	3	3	0	0
Sébékourani (99)	60	43	7	10
Ballabougou (3)	1	0	1	0
Bouyanga (14)	6	0	6	0
Doussoudiana (16)	1	0	0	1
Laminina (26)	18	1	7	10
Mamoroubougou (65)	11	0	10	1
Niakoni (4)	1	0	1	0
Niamou (225)	42	16	4	22
Npiébougou (60)	1	0	1	0
Sadjouroubougou (9)	1	0	1	0
Séoulasso (159)	20	1	11	8
Titiéna (80)	3	1	2	0
Zamoko (144)	85	20	25	40
Total	274	102	76	96

on the venter was not helpful to distinguish the two species and further investigations to clearly separate *E. jogeri* from *E. ocellatus* in the field are needed.

DISCUSSION

Previous reports on the snake fauna of Mali were based on small collections, totalizing together about two hundred specimens. Our collection of snakes from Mali comprises 5,224 specimens belonging to 60 species. With additional museum material examined and taking into account reliable literature reports, the snake fauna of Mali comprises 65 species, i.e. 18 species more than the previous checklist published 20 years ago by Joger & Lambert (1996, 1997).

As expected, maximum diversity was observed in the southern part of the country, between 11°00'N and 12°00'N (Table 4). In this area of transition between the Sudanese and the Guinean savannas 46 species were collected, with a maximum of 36 species at Mamoroubougou (11°14'N), a locality near a small river with a preserved forest gallery which was extensively investigated both for fossorial and non-fossorial species (Fig. 7). The most abundant species between 11°00'N and 12°00'N were *Tricheilostoma bicolor*, *Naja katiensis*, *Echis ocellatus*, *Psammophis* aff. *sibilans*, *Crotaphopeltis hotamboeia* and *Causus maculatus*, and other common species were *Rhamphiophis oxyrhynchus*, *Bitis arietans*, *Boaedon fuliginosus*, *Psammophis elegans*, *Prosymna greigerti*, and *Boaedon lineatus*. Eight Guinean savanna species – most of them collected in very low numbers – reach their northern limit in Mali south of 11°30'N, i.e. *Psammophis phillipsi*, *Amblyodipsas unicolor*, *Grayia smithi*, *Lycophidion irroratum*, *Polemon neuwiedi*, *Myriopholis albiventer*, *Rhinoguinea magna*, and *Afronatrix anoscopus*, and four additional Guinean species were not collected north of 12°N, namely *Afrotyphlops lineatus*, *Atractaspis dahomeyensis*, *Crotaphopeltis hippocrepis* and *Lycophidion semicinctum*.

Between 12°00'N and 14°00'N, an area of typical Sudanese savanna (Fig. 8), a total of 43 species were collected, with a maximum of 28 and 25 species, respectively, in Sébékourani (12°12'N) and Zamoko (13°09'N), two localities also extensively investigated for fossorial species (Fig. 9). The most abundant species were *Echis ocellatus* (with *E. jogeri* in the western part of the country), *Psammophis* aff. *sibilans*, *Crotaphopeltis hotamboeia*, *Causus maculatus*, *Tricheilostoma bicolor*, *Naja katiensis*, and *Myriopholis boueti*, and other common species were *Boaedon fuliginosus*, *Psammophis elegans*, *Boaedon lineatus*, *Rhamphiophis oxyrhynchus*, and *Lycophidion albomaculatum* (in the western part of the country). Four Sahelian species were collected south of 14°N, but the number and proportion of specimens was low: only five specimens of *Eryx muelleri* compared to 169 specimens north of 14°N, with a southernmost record at Niamasso (12°59'N), and only two specimens of *Echis leucogaster* compared to 521 specimens north of 14°N, with a southernmost record at Séoulasso (13°14'N). Two other Sahelian species were collected in very low number and proportion south of 14°N at Séoulasso: *Dasypeltis sahelensis* (two compared to 21), and *Atractaspis watsoni* (one compared to three).

Between 14°N and 15°N, an area of rapid transition with the Sahel (Fig. 10), a total of 27 species were collected, but only 17 of these species were collected or are known north of 14°30'N. Five species represented together 90% of the snakes collected: *Echis leucogaster*, *Psammophis* aff. *sibilans*, *Echis ocellatus*, *Echis jogeri*, and *Eryx muelleri*. Only two other species reached 1% of the specimens collected: *Crotaphopeltis hotamboeia* and *Myriopholis boueti*.

Between 15°N and 16°N, a typical Sahelian area (Fig. 11), 14 species were collected, with two of them (namely *Psammophis* aff. *sibilans* and *Echis leucogaster*) representing together 77% of the snakes collected. Other common species were *Eryx muelleri* and *Rhagerhis moilensis*. Only four species widely distributed in the southern part of the country were also collected: *Naja nigricollis*, *Psammophis elegans*, *Python sebae*, and *Boaedon fuliginosus*.

North of 16°N, a total of 18 species are now known from Mali but only 8 were collected during our study, all between 16°N and 17°N, an area of Sahelo-Saharan transition (Fig. 12). The most abundant species were *Psammophis* aff. *sibilans* (43% of specimens collected), *Echis leucogaster* (35%), *Eryx muelleri* (9%) and *Dasypeltis sahelensis* (5%). The other species collected were *Spalerosophis diadema*, *Naja nigricollis*, *Psammophis schokari* and *Rhagerrhis moilensis*. The ten species not collected by us are either Saharan species (*Cerastes vipera*, *Cerastes cerastes*, *Myriopholis algeriensis*), or species with a large distribution in Africa but apparently rare in Mali (*Naja haje*, which seems excluded by *Naja senegalensis* from most parts of Mali, and *Natriciteres olivacea*, a rare species in West Africa), or species that we collected south of 16°N but not in northern Mali (*Telescopus tripolitanus*, a species known from Kidal, *Echis jogeri*, a species with Tombouctou as type locality, and three species collected in the past along the banks of the Niger River near Gao or Tombouctou, i.e. *Philothamnus irregularis*, *Philothamnus semivariegatus* and *Psammophis elegans*.

In all areas of the country, both the number and the proportion of highly venomous snakes were very high. The three *Echis* species represented together 28% of the snakes collected (34% when excluding Leptotyphlopidae) and were the most common snakes in all areas of the country, with *E. leucogaster* as dominant species north of 14°N, *E. ocellatus* east of 8°W and *E. jogeri* in the Mandingue Plateau west of 8°W. The high mortality due to snakebite

Table 4. Latitudinal distribution of snakes in Mali (our study, 5,224 specimens collected). For the five species not collected during our study, studied museum specimens, literature data and sight records are indicated in brackets. Latitude for the northernmost record in Mali is based on whole data including literature data (circa 5,400 specimens).

Species	11°N	12°N	13°N	14°N	15°N	≥16°N	Total	Northernmost record in Mali
Cerastes vipera	0	0	0	0	0	(4)	(4)	20°40'N
Cerastes cerastes	0	0	0	0	0	(5)	(5)	20°12'N
Echis leucogaster	0	0	2	397	63	61	523	18°26'N
Telescopus tripolitanus	0	0	0	5	3	0	8	18°26'N
Rhagerhis moilensis	0	0	0	0	7	1	8	18°00'N
Myriopholis algeriensis	0	0	0	0	0	(2)	(2)	16°57'N
Psammophis schokari	0	0	0	0	1	3	4	16°46'N
Naja haje	0	0	0	0	0	(2)	(2)	16°46'N
Echis ocellatus + *E. jogeri*	251	132	311	239	0	0	933	16°46'N
Eryx muelleri	0	1	4	142	11	16	174	16°44'N
Psammophis aff. *sibilans*	112	105	172	191	67	75	722	16°44'N
Spalerosophis diadema	0	0	0	0	2	6	8	16°39'N
Naja nigricollis	2	7	20	4	3	4	40	16°39'N
Psammophis elegans	40	10	32	4	5	0	91	16°16'N
Philothamnus semivariegatus	3	0	1	0	0	0	4	16°16'N
Natriciteres olivacea	0	0	0	0	0	(1)	(1)	16°16'N
Philothamnus irregularis	34	8	0	0	0	0	42	16°15'N
Dasypeltis sahelensis	0	0	2	8	5	8	23	16°04'N
Causus maculatus	81	31	74	1	0	0	187	15°10'N
Prosymna collaris	0	0	0	0	1	0	1	15°08'N
Lycophidion albomaculatum	0	21	9	3	0	0	33	15°08'N
Python sebae	5	8	1	8	1	0	23	15°06'N
Atractaspis watsoni	0	0	1	1	2	0	4	15°02'N
Boaedon fuliginosus	41	27	19	3	2	0	92	15°01'N
Bitis arietans	44	13	13	9	0	0	79	14°52'N
Crotaphopeltis hotamboeia	82	92	36	15	0	0	225	14°45'N
Naja senegalensis	18	7	7	1	0	0	33	14°45'N
Myriopholis boueti	26	13	75	11	0	0	126	14°30'N
Rhamphiophis oxyrhynchus	58	10	22	7	0	0	97	14°30'N
Meizodon coronatus	7	12	2	0	0	0	21	14°30'N
Psammophis praeornatus	9	2	15	2	0	0	28	14°29'N
Bamanophis dorri	0	0	28	9	0	0	37	14°21'N
Prosymna greigerti	34	8	4	2	0	0	48	14°20'N
Atractaspis micropholis	0	0	0	1	0	0	1	14°20'N
Afrotyphlops punctatus	13	0	6	2	0	0	21	14°09'N
Tricheilostoma bicolor	725	9	101	3	0	0	838	14°09'N
Dasypeltis confusa	2	0	0	0	0	0	2	14°09'N
Dasypeltis latericia	3	1	16	5	0	0	25	14°01'N
Python regius	26	23	5	1	0	0	55	14°01'N
Boaedon lineatus	31	24	15	0	0	0	70	13°14'N
Dasypeltis gansi	0	2	1	0	0	0	3	13°14'N
Elapsoidea semiannulata	17	3	8	0	0	0	28	13°14'N
Naja cf. *melanoleuca*	10	1	1	0	0	0	12	13°14'N
Dispholidus typus	16	0	3	0	0	0	19	13°09'N
Mehelya crossi	26	5	2	0	0	0	33	13°09'N
Naja katiensis	250	18	88	0	0	0	356	13°09'N
Rhinoleptus koniagui	9	1	1	0	0	0	11	13°09'N
Telescopus variegatus	2	0	6	0	0	0	8	13°09'N
Psammophis lineatus	2	0	0	0	0	0	2	12°43'N
Atractaspis aterrima	4	1	0	0	0	0	5	12°35'N
Gonionotophis granti	3	1	0	0	0	0	4	12°12'N
Myriopholis adleri	0	1	0	0	0	0	1	12°12'N
Afrotyphlops lineatus	12	0	0	0	0	0	12	11°59'N
Atractaspis dahomeyensis	10	0	0	0	0	0	10	11°59'N
Crotaphopeltis hippocrepis	3	0	0	0	0	0	3	11°59'N
Lycophidion semicinctum	24	0	0	0	0	0	24	11°59'N
Afronatrix anoscopus	17	0	0	0	0	0	17	11°26'N
Amblyodipsas unicolor	5	0	0	0	0	0	5	11°14'N
Grayia smithi	15	0	0	0	0	0	15	11°14'N
Lycophidion irroratum	5	0	0	0	0	0	5	11°14'N
Polemon neuwiedi	3	0	0	0	0	0	3	11°14'N
Myriopholis albiventer	5	0	0	0	0	0	5	11°14'N
Rhinoguinea magna	16	0	0	0	0	0	16	11°14'N
Psammophis phillipsi	1	0	0	0	0	0	1	11°12'N
Number of specimens	**2103**	**597**	**1103**	**1074**	**173**	**174**	**5224**	
Number of species	**46**	**32**	**36**	**27**	**14**	**8 (+5)**	**60 (+5)**	

in south-eastern Senegal was attributed to *Echis jogeri* (Trape et al. 2001) and the other species of the *Echis ocellatus* complex are also known to be a major cause of death in savanna areas of Nigeria (Warrell & Arnett 1976). Several other dangerous species were both common and widespread, e.g. *Bitis arietans*, *Naja nigricollis*, and *Naja senegalensis*. The Katian spitting cobra *Naja katiensis* was among the most abundant snakes in Mali but the severity of its bite is poorly documented. Together, the potentially deadly snakes represented 38% of the snakes collected during our study and 47% of snakes when excluding worm snakes of the family Leptotyphlopidae.

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APPENDIX 1

List of collected specimens, locality, and IRD collection number

Afronatrix anoscopus. **Mamoroubougou**: 1991.M, 1993.M, 1995.M, 2006.M, 2007.M, 2009.M, 2016.M, 2038.M, 2049.M, 2056.M, 3692.M, 3750.M, 3761.M, 3766.M, 3784.M, 3823.M; **Titiéna**: 3689.M.

Afrotyphlops lineolatus. **Npiébougou**: 3992.M, 4152.M, 4153.M, 4154.M, 4155.M, 4156.M, 4157.M, 4164.M, 4166.M, 4168.M, TR.2504; **Laminina**: 174.M.

Afrotyphlops punctatus. **Niamou**: 1924.M, 4264.M (ligné); **Npiébougou**: 4286.M (ligné); **Titiéna**: 2125.M, 4171.M, 4176.M (ligné); **Zamoko**: 4149.M, 4150.M, 4151.M (ligné); **Laminina**: 754.M (marbré); **Mamoroubougou**: 4134.M, 4145.M, 4146.M, 4147.M, 4148.M, 4158.M, TR.2503 (marbré); **Titiéna**: 1932.M (marbré); **Zamoko**: 160.M, 1916.M, 1921.M (noir).

Amblyodipsas unicolor. **Mamoroubougou**: 1947.M, 1979.M, 3557.M, 3790.M, 3796.M.

Atractaspis aterrima. **Doussoudiana**: 111.M, TR.0712; **Laminina**: TR.0649; **Mamoroubougou**: 3850.M; **Sadjouroubougou**: 2521.M.

Atractaspis dahomeyensis. **Mamoroubougou**: 1936.M, 1941.M, 1989.M, 2029.M, 2036.M, 3734.M, 3767.M; **Npiébougou**: 1808.M, 4165.M; **Titiéna**: 3659.M.

Atractaspis micropholis. **Niamou**: 1923.M.

Atractaspis watsoni. **Samé Ouolof**: TR.1684; **Séoulasso**: 1493.M; **Topokhoné**: 126.M, 128.M.

Bamanophis dorri. **Bangaya**: 1.M, 9.M, 11.M, 14.M, 15.M, 19.M, 23.M, 26.M, 28.M, 31.M, 228.M, 231.M, 243.M, 259.M, 264.M, 265.M, 266.M, 277.M, 278.M, 279.M, 292.M, 295.M, 296.M, 297.M; **Koundian**: 69.M, 2364.M, 3012.M, 3018.M; **Niamou**: 44.M, 2977.M, 2978.M, 2983.M, 2987.M, 2995.M, 2997.M, 3000.M; **Toumboula**: 2799.M.

Bitis arietans. **Bangaya**: 20.M, 25.M, 219.M, 223.M, 226.M, 236.M, 244.M, 290.M, 298.M; **Bouyanga**: 55.M, 400.M, 403.M; **Djinagué**: 1160.M, 1205.M; **Doussoudiana**: 90.M, 125.M, 1760.M, 1771.M, TR.0917; **Gouina** (chutes): 5299.M; **Koundian**: 64.M, 2373.M; **Laminina**: 762.M, 788.M, 820.M,

TR.0922, TR.1100, TR.1225, TR.1309, TR.1314; **Mamoroubougou**: 175.M, 2060.M, 2064.M, 4111.M, 4118.M; **Niakoni**: TR.0932; **Niamasso**: 1344.M; **Niamou**: 420.M, 422.M, 436.M, 2988.M, 2993.M; **Npiébougou**: 1852.M, 1884.M, 3327.M, 3375.M, 3425.M, 3434.M, 3449.M, 3454.M, 3462.M, 3477.M, 3490.M, 3498.M, 3999.M, **Sébékourani**: 944.M, 961.M, 1000.M, 1002.M, 1041.M, 1081.M, 1082.M, 3243.M, 3246.M, 3270.M; **Titiéna**: 2112.M, 2151.M, 2180.M, 2263.M, 3675.M, 4015.M, 4021.M, 4023.M, 4024.M, 4025.M, 4027.M, 4033.M; **Zamoko**: 662.M, 2558.M.

Boaedon fuliginosus. **Bangaya**: 225.M, 239.M, 272.M; **Bouyanga**: 2500.M; **Djinagué**: 1111.M, 1114.M, 1133.M, 1134.M, 1151.M, 1166.M, 1194.M; **Doussoudiana**: 94.M, 112.M, TR.1203, TR.1235; **Kinani**: 1564.M, 1584.M; **Koundian**: 71.M, 72.M, 2369.M, 3025.M, 3032.M; **Laminina**: 757.M, 766.M, 776.M, 790.M, 792.M, 819.M, 2622.M, TR.0647; **Mamoroubougou**: 1939.M, 1980.M, 1988.M, 3696.M, 3720.M, 3722.M, 3724.M, 3745.M, 3771.M, 3780.M, 3781.M, 3794.M, 3797.M, 3800.M, 3819.M, 3844.M; **Niamou**: 484.M, 2923.M; **Npiébougou**: 1809.M, 1810.M, 1843.M, 1868.M, 1869.M, 1870.M, 3313.M, 3376.M, 3386.M, 3416.M, 3478.M; **Sébékourani**: 876.M, 882.M, 899.M, 920.M, 938.M, 975.M, 1040.M, 1075.M, 1079.M, 1086.M, 3161.M, 3180.M, 3208.M, 3230.M, 3232.M, 3236.M, 3237.M, 3239.M, 3266.M, 3290.M; **Séoulasso**: 1715.M, 3094.M; **Titiéna**: 2073.M, 2130.M; **Zamoko**: 564.M, 566.M, 570.M, 670.M, 672.M, 679.M, 696.M, 2602.M, 2658.M.

Boaedon lineatus. **Bangaya**: 221.M, 275.M, 291.M; **Djinagué**: 1119.M, 1128.M, 1145.M, 1161.M, 1168.M, 1186.M, 1201.M, 3293.M; **Doussoudiana**: 119.M; **Koundian**: 65.M, 66.M, 3001.M, 3021.M; **Laminina**: 824.M, 848.M; **Mamoroubougou**: 2026.M, 2046.M, 2058.M, 2059.M, 3751.M, 3774.M, 3785.M, 3786.M, 3813.M, 3827.M, 3848.M, 3853.M; **Npiébougou**: 1779.M, 1854.M, 1875.M, 3357.M, 3441.M; **Sadjouroubougou**: 2512.M; **Sébékourani**: 872.M, 888.M, 907.M, 908.M, 909.M, 918.M, 925.M, 927.M, 3158.M, 3166.M, 3201.M, 3212.M, 3245.M, 3253.M, 3267.M; **Séoulasso**: 3086.M, 3128.M; **Titiéna**: 191.M, 2104.M, 2134.M, 2156.M, 2164.M, 2178.M, 2199.M, 2203.M, 2256.M, 3668.M, 4032.M; **Zamoko**: 671.M, 2534.M, 2593.M, 2606.M, 2641.M, 2702.M.

Causus maculatus. **Bangaya**: 17.M, 30.M, 224.M, 257.M, 258.M, 260.M, 273.M, 282.M, 286.M, 299.M, 301.M, **Djinagué**: 1118.M, 1120.M, 1123.M, 1124.M, 1154.M, 1156.M, 1158.M, 1180.M, 1188.M, 1192.M, **Doussoudiana**: 84.M, 1761.M, 1763.M, 1765.M, 1768.M, 1769.M, 1773.M, TR.0715, TR.0718, TR.0851, TR.1233, TR.1304; **Koundian**: 61.M, 67.M, 2366.M, 3010.M, 3019.M, 3034.M, 3035.M, 3043.M; **Laminina**: 761.M, 782.M, 796.M, 806.M, 812.M, 813.M, 816.M, 836.M, 851.M, 856.M, 858.M; **Mamoroubougou**: 2033.M, 2035.M, 2050.M, 2063.M, 2066.M, 3749.M, 3802.M, 3829.M, 3831.M, 4103.M, 4123.M, 4127.M, 4131.M, 4132.M, 4140.M; **Niamou**: 2986.M; **Npiébougou**: 1799.M, 1829.M, 1840.M, 3324.M, 3398.M, 3428.M, 3465.M; **Sébékourani**: 864.M, 902.M, 913.M, 940.M, 959.M, 962.M, 1013.M, 1037.M, 1050.M, 1060.M, 1105.M, 3169.M, 3203.M, 3204.M, 3210.M, 3218.M, 3224.M, 3241.M, 3247.M, 3249.M, 3264.M; **Titiéna**: 195.M, 2082.M, 2084.M, 2137.M, 2153.M, 2154.M, 2165.M, 2171.M, 2194.M, 2202.M, 2234.M, 2241.M, 2262.M, 3609.M, 3610.M, 3611.M, 3641.M, 3674.M, 3684.M, 4011.M, 4012.M, 4013.M, 4014.M, 4016.M, 4018.M, 4020.M, 4028.M, 4030.M, 4031.M, 4034.M, 4036.M, 4038.M, 4039.M, 4303.M, 4304.M, 4305.M; **Zamoko**: 567.M, 583.M, 590.M, 593.M, 600.M, 614.M, 637.M, 641.M, 642.M, 648.M, 657.M, 664.M, 669.M, 689.M, 692.M, 693.M, 702.M, 704.M, 723.M, 730.M, 735.M, 736.M, 737.M, 2532.M, 2533.M, 2537.M, 2538.M, 2542.M, 2552.M, 2555.M, 2557.M, 2559.M, 2562.M, 2574.M, 2575.M, 2576.M, 2585.M, 2594.M, 2595.M, 2605.M, 2608.M, 2609.M, 2616.M, 2633.M, 2640.M, 2642.M, 2646.M, 2647.M, 2648.M, 2672.M, 2690.M, 2691.M, 2692.M, 2693.M, 2694.M.

Crotaphopeltis hippocrepis. **Mamoroubougou**: TR.2502; **Npiébougou**: 1856.M.

Crotaphopeltis hotamboeia. **Ballabougou**: 2525.M; **Bangaya**: 12.M, 18.M, 21.M, 227.M, 229.M, 232.M, 233.M, 234.M, 237.M, 240.M, 241.M, 242.M, 251.M, 253.M, 254.M, 255.M, 256.M, 261.M, 263.M, 269.M, 271.M, 280.M, 281.M, 284.M, 293.M, 300.M; **Djinagué**: 1109.M, 1112.M, 1121.M, 1126.M, 1127.M, 1131.M, 1136.M, 1137.M, 1140.M, 1143.M, 1146.M, 1147.M, 1148.M, 1149.M, 1150.M, 1153.M, 1163.M, 1169.M, 1174.M, 1176.M, 1177.M, 1184.M, 1185.M, 1190.M, 1195.M, 1196.M, 1198.M, 1200.M, 1208.M; **Doussoudiana**: 79.M, 86.M, 97.M, 104.M, 105.M, 123.M, 1758.M, TR.0717, TR.0844, TR.0915, TR.0916, TR.0919, TR.1236; **Laminina**: 738.M, 742.M, 744.M, 746.M, 748.M, 778.M, 841.M, 843.M, TR.1230, TR.1274; **Mamoroubougou**: 2014.M, 2044.M, 3691.M, 3717.M, 3746.M, 3747.M, 3759.M, 3791.M, 3793.M, 3798.M, 3801.M, 3809.M, 3820.M, 3824.M, 3826.M, 3830.M, 3839.M, 3841.M, 3842.M, 4106.M, 4107.M, 4130.M, 4136.M, 4138.M, 4161.M; **Niakoni**: TR.0933, TR.1296; **Niamasso**: 1341.M, 1343.M; **Niamou**: 38.M, 40.M, 461.M, 2979.M, 2980.M, 2994.M, TR.0257, TR.0258; **Npiébougou**: 1780.M, 1806.M, 1815.M, 1817.M, 1823.M, 1861.M, 1862.M, 3337.M, 3361.M, 3467.M, 3491.M; **Sadjouroubougou**: 2513.M, 2514.M; **Saré-Soma**: 1594.M, 1614.M; **Sébékourani**: 867.M, 868.M, 870.M, 874.M, 877.M, 887.M, 889.M, 892.M, 893.M, 894.M, 895.M, 901.M, 904.M, 905.M, 906.M, 910.M, 914.M, 919.M, 921.M, 924.M, 926.M, 932.M, 933.M, 935.M, 942.M, 948.M, 950.M, 952.M, 956.M, 965.M, 978.M, 990.M, 1001.M, 1009.M, 1014.M, 1027.M, 1043.M, 1069.M, 3155.M, 3163.M, 3168.M, 3171.M, 3175.M, 3177.M, 3179.M, 3182.M, 3199.M, 3202.M, 3217.M, 3222.M, 3225.M, 3231.M, 3235.M, 3248.M, 3262.M, 3263.M, 3274.M, 3279.M; **Séoulasso**: 1388.M; **Titiéna**: 211.M, 215.M, 2074.M, 2075.M, 2077.M, 2081.M, 2085.M, 2088.M, 2093.M, 2099.M, 2122.M, 2123.M, 2124.M, 2144.M, 2168.M, 2170.M, 2174.M, 2218.M, 2226.M, 2235.M, 2242.M, 3621.M; **Toumboula**: 1272.M, 1281.M, 2794.M, 2796.M, 2797.M; **Zamoko**: 595.M, 610.M, 649.M, 2563.M, 2572.M, 2580.M, 2654.M, 2664.M, 2707.M.

Dasypeltis confusa. **Mamoroubougou**: 3731.M, 4104.M.

Dasypeltis gansi. **Ballabougou**: 2355.M, 2356.M; **Séoulasso**: 4141.M.

Dasypeltis latericia. **Bangaya**: 27.M, 276.M, 285.M, 288.M; **Koundian**: 2371.M; **Niamou**: 138.M, 139.M, 2357.M, 2358.M, 2359.M; **Npiébougou**: 4315.M, 4316.M; **Sébékourani**: 153.M; **Séoulasso**: 1351.M, 1714.M, 1715.M, 4163.M; **Titiéna**: 1930.M; **Zamoko**: 161.M, 162.M, 163.M, 171.M, 172.M, 2619.M, 4063.M.

Dasypeltis sahelensis. **Bouyanga**: 130.M, 412.M, 2361.M, 2362.M, 2363.M; **Gaoudel**: 1535.M, 3561.M, 3567.M, 3573.M, 3583.M; **Séoulasso**: 1395.M, 1505.M; **Toumboula**: 1230.M, 1231.M, 2360.M.

Dispholidus typus. **Doussoudiana**: 98.M; **Laminina**: 743.M, 763.M, 784.M, 795.M, TR.1227; **Mamoroubougou**: 1976.M, 2002.M, 2011.M, 3693.M, 3748.M, 3777.M, 3789.M; **Npiébougou**: 3346.M, 3417.M; **Sébékourani**: 998.M; **Titiéna**:

2267.M ; **Zamoko**: 170.M , 602.M , 2554.M .

Echis leucogaster. **Agoudoud**: 1679.M , 1680.M ; **Boussouma**: 1741.M , 1742.M ; **Bouyanga**: 48.M , 49.M , 50.M , 51.M , 53.M , 54.M , 135.M , 136.M , 302.M , 303.M , 304.M , 305.M , 306.M , 307.M , 308.M , 309.M , 310.M , 311.M , 312.M , 313.M , 314.M , 315.M , 316.M , 317.M , 318.M , 319.M , 320.M , 321.M , 322.M , 323.M , 324.M , 325.M , 326.M , 327.M , 328.M , 329.M , 330.M , 331.M , 332.M , 333.M , 334.M , 336.M , 337.M , 338.M , 339.M , 346.M , 347.M , 348.M , 349.M , 350.M , 351.M , 352.M , 353.M , 354.M , 356.M , 357.M , 358.M , 359.M , 361.M , 362.M , 363.M , 364.M , 365.M , 366.M , 367.M , 368.M , 369.M , 371.M , 374.M , 376.M , 377.M , 380.M , 381.M , 383.M , 384.M , 385.M , 389.M , 390.M , 391.M , 396.M , 399.M , 407.M , 408.M , 409.M , 410.M , 414.M , 416.M , 2382.M , 2384.M , 2387.M , 2431.M , 2432.M , 2433.M , 2434.M , 2435.M , 2436.M , 2437.M , 2438.M , 2439.M , 2440.M , 2441.M , 2442.M , 2443.M , 2444.M , 2445.M , 2446.M , 2447.M , 2448.M , 2449.M , 2450.M , 2451.M , 2452.M , 2453.M , 2454.M , 2455.M , 2456.M , 2457.M , 2458.M , 2459.M , 2460.M , 2461.M , 2462.M , 2463.M , 2464.M , 2465.M , 2466.M , 2467.M , 2468.M , 2469.M , 2470.M , 2471.M , 2472.M , 2473.M , 2474.M , 2475.M , 2476.M , 2477.M , 2478.M , 2479.M , 2480.M , 2481.M , 2482.M , 2483.M , 2484.M , 2485.M , 2486.M , 2487.M , 2488.M , 2489.M , 2490.M , 2491.M , 2492.M , 2493.M , 2494.M , 2495.M , 2496.M , 2497.M , 2498.M , 4076.M , 4077.M , 4078.M , 4080.M , 4081.M , 4082.M , 4083.M , 4084.M , 4085.M , 4086.M , 4087.M , 4088.M , 4089.M , 4091.M , 4092.M , 4093.M , 4094.M , 4095.M , 4096.M , 4097.M , 4306.M , 4307.M , 4308.M , 4309.M , 4310.M , 4311.M , 4312.M , 4313.M , TR.2868, TR.2869, TR.2870; **Doro**: 1688.M , 1689.M , 1690.M ; **Gaoudel**: 1531.M , 1532.M , 1536.M , 1539.M , 1540.M , 1542.M , 1546.M , 1547.M , 3527.M , 3531.M , 3532.M , 3534.M , 3536.M , 3538.M , 3541.M , 3545.M , 3547.M , 3548.M , 3549.M , 3554.M , 3559.M , 3560.M , 3564.M , 3569.M , 3572.M , 3575.M , 3576.M , 3577.M , 3578.M , 3579.M , 3580.M , 3581.M , 3584.M , 3585.M , 3586.M , 3587.M , 3588.M , 3589.M , 3591.M , 3592.M , 3593.M , 3594.M , 3595.M , 3596.M ; **Haoussa-Foulane**: 2273.M , 2275.M , 2276.M ; **Kinani**: 1548.M , 1552.M , 1555.M , 1559.M , 1570.M , 1579.M , 1581.M , 1582.M , 1583.M , 1585.M ; **Koyretao**: 1617.M , 1619.M , 2319.M , 2320.M , 2321.M , 2322.M , 2323.M , 2324.M , 2326.M , 2327.M , 2328.M , 2329.M , 2330.M , 2331.M , 2334.M , 2337.M , 2341.M , 2342.M , 3502.M , 3504.M , 3505.M , 3507.M , 3511.M , 3513.M , 3514.M , 3517.M , 3518.M , 3519.M , 3521.M , 3526.M , TR.1482; **Léré**: 2346.M ; **Niamou**: 426.M , 438.M , 450.M , 459.M , 490.M , 2926.M , 2929.M , 2930.M , 2931.M , 2937.M , 2939.M , 2941.M , 2943.M , 2944.M , 2947.M , 2950.M , 2952.M , 2955.M , 2957.M , 2958.M , 2960.M , 2961.M , 2962.M , 2963.M , 2965.M , 2973.M , 3870.M , 3871.M , 3875.M , 3878.M , 3884.M , 3886.M , 3893.M , 3895.M , 3925.M , 3935.M , 3943.M , 3964.M , 3973.M , 3985.M , 4052.M , 4292.M , 4293.M , 4294.M , 4295.M ; **Samé Ouolof**: 1748.M , 1749.M , 1753.M , 1896.M , 1900.M , 1901.M , 1902.M , 1904.M , 1905.M , 1907.M , 1908.M , 1909.M , 1913.M , 1914.M , 3061.M , 3064.M , 3069.M , 3071.M , 3074.M , 3077.M , 3078.M ; **Séoulasso**: 1399.M , 1416.M ; **Tacharane**: 1889.M , 1890.M , 1891.M , 1892.M , 1893.M , 1894.M , 1895.M , 2277.M , 2278.M , 2279.M , 2280.M ; **Tinjemban**: 1621.M , 1625.M , 1626.M , 1627.M , 1628.M , 1629.M , 1630.M , 1631.M , 1632.M , 1634.M , 1635.M , 1636.M , 1637.M , 2282.M , 2283.M , 2284.M ; **Topokhoné**: 127.M ; **Toumboula**: 1232.M , 1233.M , 1234.M , 1236.M , 1237.M , 1238.M , 1239.M , 1240.M , 1241.M , 1242.M , 1243.M , 1244.M , 1245.M , 1246.M , 1247.M , 1248.M , 1249.M , 1250.M , 1251.M , 1252.M , 1253.M , 1254.M , 1255.M , 1256.M , 1258.M , 1260.M , 1261.M , 1262.M , 1263.M , 1265.M , 1266.M , 1267.M , 1268.M , 1269.M , 1270.M , 1271.M , 1273.M , 1274.M , 1275.M , 1276.M , 1277.M , 1278.M , 1279.M , 1280.M , 1282.M , 1284.M , 1285.M , 1286.M , 1287.M , 1288.M , 1289.M , 1290.M , 1291.M , 1292.M , 1293.M , 1294.M , 1295.M , 1296.M , 1297.M , 1298.M , 1299.M , 1301.M , 1302.M , 1303.M , 1304.M , 1305.M , 1306.M , 1307.M , 1308.M , 1309.M , 1310.M , 1311.M , 1312.M , 1313.M , 1314.M , 2719.M , 2720.M , 2721.M , 2722.M , 2723.M , 2724.M , 2725.M , 2726.M , 2727.M , 2728.M , 2729.M , 2730.M , 2731.M , 2732.M , 2733.M , 2734.M , 2735.M , 2736.M , 2737.M , 2738.M , 2739.M , 2740.M , 2741.M , 2742.M , 2743.M , 2744.M , 2745.M , 2746.M , 2747.M , 2748.M , 2749.M , 2750.M , 2751.M , 2752.M , 2753.M , 2754.M , 2755.M , 2756.M , 2757.M , 2758.M , 2759.M , 2760.M , 2761.M , 2762.M , 2763.M , 2764.M , 2765.M , 2766.M , 2767.M , 2768.M , 2769.M , 2770.M , 2771.M , 2772.M , 2773.M , 2774.M , 2774.M , 2775.M , 2776.M , 2777.M , 2778.M , 2779.M , 2780.M , 2781.M , 2782.M , 2783.M , 2784.M , 2785.M , 2786.M , 2787.M .

Echis ocellatus **(complex, including *E. jogeri*)**. **Ballabougou**: 2526.M , 2527.M , 2528.M ; **Bangaya**: 32.M , 33.M , 283.M , 294.M ; **Bouyanga**: 131.M , 132.M , 133.M , 134.M , 137.M , 335.M , 397.M , 402.M , 413.M , 415.M , 4079.M , 4090.M , TR.2874; **Djinagué**: 1116.M , 1142.M , 1162.M , 1173.M , 1178.M , 1183.M , 1191.M , 1203.M , 1204.M , 1206.M , 1207.M , 1210.M , 1216.M , 1219.M , 1221.M , 1224.M , 1225.M , 1226.M , 1227.M , 1228.M ; **Doussoudiana**: 73.M , 80.M , 92.M , 95.M , 99.M , 106.M , 107.M , 116.M , 121.M , 122.M , 124.M , TR.0716, TR.0918, TR.1270, TR.1307; **Koundian**: 68.M , 70.M , 2370.M , 3042.M ; **Laminina**: 755.M , 775.M , 786.M , 791.M , 794.M , 799.M , 800.M , 810.M , 811.M , 834.M , 835.M , 837.M , 840.M , 844.M , 846.M , 849.M , 850.M , 853.M , 855.M , 857.M , 859.M , 2621.M , TR.0926, TR.1231, TR.1276, TR.1280; **Mamoroubougou**: 179.M , 180.M , 1986.M , 1994.M , 2021.M , 2022.M , 2028.M , 2032.M , 2034.M , 2037.M , 2039.M , 2043.M , 2045.M , 2047.M , 2057.M , 3704.M , 3732.M , 3740.M , 3744.M , 3776.M , 3783.M , 3788.M , 3799.M , 3806.M , 3807.M , 3808.M , 3816.M , 3817.M , 3843.M , 3847.M , 3856.M , 3857.M , 3818.M , 3836.M , 3846.M , 4098.M , 4099.M , 4100.M , 4101.M , 4102.M , 4105.M , 4108.M , 4109.M , 4112.M , 4113.M , 4114.M , 4115.M , 4116.M , 4117.M , 4119.M , 4120.M , 4121.M , 4122.M , 4124.M , 4125.M , 4126.M , 4128.M , 4129.M , 4133.M , 4135.M , 4137.M , 4139.M , 4170.M , 4298.M , TR.2879; **Niakoni**: TR.0930, TR.0931, TR.1232, TR.1299; **Niamou**: 35.M , 37.M , 39.M , 43.M , 45.M , 46.M , 47.M , 57.M , 435.M , 439.M , 441.M , 446.M , 449.M , 451.M , 452.M , 453.M , 456.M , 457.M , 458.M , 464.M , 465.M , 466.M , 470.M , 474.M , 475.M , 476.M , 477.M , 481.M , 482.M , 483.M , 485.M , 486.M , 487.M , 491.M , 493.M , 494.M , 496.M , 498.M , 500.M , 501.M , 503.M , 504.M , 505.M , 506.M , 507.M , 508.M , 509.M , 510.M , 517.M , 518.M , 519.M , 520.M , 521.M , 522.M , 523.M , 525.M , 526.M , 527.M , 528.M , 2867.M , 2924.M , 2925.M , 2927.M , 2928.M , 2932.M , 2933.M , 2934.M , 2935.M , 2936.M , 2938.M , 2940.M , 2942.M , 2945.M , 2946.M , 2948.M , 2949.M , 2951.M , 2953.M , 2954.M , 2956.M , 2959.M , 2964.M , 2966.M , 2967.M , 2968.M , 2969.M , 2970.M , 2971.M , 2972.M , 2974.M , 3351.M , 3356.M , 3362.M , 3370.M , 3380.M , 3385.M , 3443.M , 3446.M , 3447.M , 3448.M , 3450.M , 3453.M , 3455.M , 3456.M , 3457.M , 3458.M , 3459.M , 3466.M , 3470.M , 3473.M , 3474.M , 3479.M , 3480.M , 3482.M , 3484.M , 3485.M , 3486.M , 3487.M , 3492.M , 3493.M , 3496.M , 3858.M , 3859.M , 3860.M , 3861.M , 3862.M , 3863.M , 3864.M , 3865.M , 3866.M , 3867.M , 3868.M , 3869.M , 3872.M , 3873.M , 3874.M , 3876.M , 3877.M , 3879.M , 3880.M , 3881.M , 3882.M , 3883.M , 3885.M , 3887.M , 3888.M , 3889.M , 3890.M , 3891.M , 3892.M , 3894.M , 3896.M , 3897.M , 3898.M , 3899.M , 3900.M , 3901.M , 3902.M , 3903.M , 3904.M , 3905.M , 3906.M , 3907.M , 3908.M , 3909.M , 3910.M , 3911.M , 3912.M , 3913.M , 3914.M , 3915.M , 3916.M , 3917.M , 3918.M , 3919.M , 3920.M , 3921.M , 3922.M , 3923.M ,

3924.M, 3926.M, 3927.M, 3928.M, 3929.M, 3930.M, 3931.M, 3932.M, 3933.M, 3934.M, 3936.M, 3937.M, 3938.M, 3939.M, 3940.M, 3941.M, 3942.M, 3944.M, 3945.M, 3946.M, 3947.M, 3948.M, 3949.M, 3950.M, 3951.M, 3952.M, 3953.M, 3954.M, 3955.M, 3956.M, 3957.M, 3958.M, 3959.M, 3960.M, 3961.M, 3962.M, 3963.M, 3965.M, 3966.M, 3967.M, 3968.M, 3969.M, 3970.M, 3971.M, 3972.M, 3974.M, 3975.M, 3976.M, 3977.M, 3978.M, 3979.M, 3980.M, 3981.M, 3982.M, 3983.M, 3984.M, 3986.M, 3987.M, 3988.M, 3989.M, 3990.M, 3991.M, 4044.M, 4045.M, 4046.M, 4047.M, 4048.M, 4049.M, 4050.M, 4051.M, TR.0253, TR.0254, TR.0255, TR.2872, TR.2873; **Npiébougou**: 1789.M, 1800.M, 1814.M, 1816.M, 1819.M, 1833.M, 1834.M, 1842.M, 1850.M, 1864.M, 1873.M, 1874.M, 1877.M, 1883.M, 3373.M, 3993.M, 3995.M, 3997.M, 4000.M, 4001.M, 4006.M, 4007.M, 4009.M, 4010.M, 4194.M, 4195.M, TR.2875, TR.2876, TR.2877; **Sadjouroubougou**: 1316.M, 1318.M, 1319.M, 1330.M, 2515.M, 2516.M, 2517.M, 2518.M, 2519.M; **Sébékourani**: 151.M, 880.M, 898.M, 911.M, 915.M, 916.M, 917.M, 923.M, 929.M, 930.M, 934.M, 936.M, 939.M, 941.M, 943.M, 945.M, 946.M, 947.M, 949.M, 951.M, 954.M, 955.M, 960.M, 963.M, 968.M, 969.M, 970.M, 973.M, 974.M, 976.M, 977.M, 979.M, 1004.M, 1005.M, 1008.M, 1010.M, 1011.M, 1015.M, 1017.M, 1018.M, 1019.M, 1020.M, 1023.M, 1024.M, 1025.M, 1031.M, 1032.M, 1034.M, 1035.M, 1038.M, 1039.M, 1042.M, 1046.M, 1047.M, 1049.M, 1052.M, 1053.M, 1056.M, 1057.M, 1058.M, 1059.M, 1063.M, 1065.M, 1066.M, 1067.M, 1068.M, 1070.M, 1071.M, 1072.M, 1073.M, 1074.M, 1076.M, 1077.M, 1078.M, 1080.M, 1083.M, 1084.M, 1085.M, 1087.M, 1088.M, 1089.M, 1090.M, 1091.M, 1092.M, 1093.M, 1094.M, 1095.M, 1096.M, 1097.M, 1098.M, 1099.M, 1101.M, 1102.M, 1107.M, 3189.M, 3200.M, 3227.M, 3260.M, 3276.M, TR.2880; **Séoulasso**: 1346.M, 1347.M, 1349.M, 1350.M, 1352.M, 1353.M, 1355.M, 1356.M, 1357.M, 1359.M, 1360.M, 1361.M, 1362.M, 1363.M, 1365.M, 1366.M, 1367.M, 1368.M, 1369.M, 1370.M, 1371.M, 1373.M, 1374.M, 1375.M, 1376.M, 1377.M, 1378.M, 1379.M, 1383.M, 1384.M, 1385.M, 1386.M, 1387.M, 1389.M, 1391.M, 1393.M, 1396.M, 1397.M, 1401.M, 1402.M, 1404.M, 1405.M, 1406.M, 1407.M, 1408.M, 1409.M, 1410.M, 1411.M, 1413.M, 1414.M, 1415.M, 1417.M, 1418.M, 1419.M, 1420.M, 1421.M, 1422.M, 1423.M, 1426.M, 1431.M, 1432.M, 1433.M, 1434.M, 1435.M, 1436.M, 1437.M, 1438.M, 1439.M, 1440.M, 1441.M, 1442.M, 1443.M, 1444.M, 1447.M, 1448.M, 1449.M, 1451.M, 1452.M, 1453.M, 1454.M, 1455.M, 1456.M, 1459.M, 1461.M, 1462.M, 1464.M, 1467.M, 1468.M, 1469.M, 1470.M, 1471.M, 1472.M, 1473.M, 1474.M, 1476.M, 1478.M, 1479.M, 1480.M, 1481.M, 1482.M, 1483.M, 1484.M, 1486.M, 1487.M, 1488.M, 1489.M, 1490.M, 1491.M, 1492.M, 1496.M, 1498.M, 1500.M, 1502.M, 1503.M, 1504.M, 1506.M, 1507.M, 1508.M, 1509.M, 1510.M, 1514.M, 1517.M, 1518.M, 1519.M, 1520.M, 1521.M, 1523.M, 1524.M, 1525.M, 1526.M, 1527.M, 1528.M, 1529.M, 1691.M, 1692.M, 1693.M, 1694.M, 1695.M, 1696.M, 1697.M, 1698.M, 1699.M, 1700.M, 1701.M, 1702.M, 1703.M, 1704.M, 1705.M, 1706.M, 1707.M, 1708.M, 1709.M, 1710.M, 1711.M, 1712.M, 3136.M, 3292.M, TR.1736, TR.2243; **Titiéna**: 200.M, 201.M, 204.M, 207.M, 208.M, 210.M, 212.M, 2067.M, 2069.M, 2083.M, 2092.M, 2094.M, 2100.M, 2114.M, 2119.M, 2120.M, 2135.M, 2147.M, 2150.M, 2157.M, 2159.M, 2166.M, 2167.M, 2173.M, 2176.M, 2181.M, 2187.M, 2189.M, 2193.M, 2198.M, 2201.M, 2204.M, 2208.M, 2211.M, 2215.M, 2217.M, 2227.M, 2229.M, 2236.M, 2240.M, 2245.M, 2246.M, 2250.M, 2253.M, 2254.M, 2257.M, 2258.M, 2264.M, 2266.M, 2268.M, 2269.M, 3612.M, 3614.M, 3615.M, 3623.M, 3644.M, 3646.M, 3649.M, 3650.M, 3657.M, 3663.M, 3666.M, 3669.M, 3670.M, 3672.M, 3681.M, 3685.M, 3688.M 3673.M, 3687.M, 4017.M, 4019.M, 4026.M, 4029.M, 4035.M, 4037.M, 4040.M, 4041.M, 4042.M, 4043.M; **Zamoko**: 157.M, 158.M, 159.M, 529.M, 568.M, 574.M, 585.M, 589.M, 591.M, 594.M, 597.M, 598.M, 599.M, 604.M, 607.M, 608.M, 611.M, 612.M, 613.M, 615.M, 616.M, 617.M, 621.M, 622.M, 623.M, 624.M, 625.M, 626.M, 627.M, 631.M, 633.M, 634.M, 636.M, 645.M, 646.M, 651.M, 652.M, 653.M, 654.M, 655.M, 656.M, 658.M, 660.M, 661.M, 663.M, 665.M, 666.M, 667.M, 668.M, 673.M, 674.M, 675.M, 676.M, 677.M, 678.M, 680.M, 682.M, 683.M, 684.M, 685.M, 686.M, 687.M, 688.M, 690.M, 691.M, 694.M, 695.M, 697.M, 698.M, 699.M, 701.M, 703.M, 706.M, 707.M, 708.M, 709.M, 711.M, 714.M, 715.M, 716.M, 717.M, 718.M, 719.M, 720.M, 721.M, 722.M, 724.M, 725.M, 727.M, 728.M, 729.M, 731.M, 732.M, 2535.M, 2539.M, 2547.M, 2548.M, 2564.M, 2568.M, 2569.M, 2577.M, 2581.M, 2596.M, 2601.M, 2625.M, 2643.M, 2645.M, 2649.M, 2657.M, 2659.M, 2665.M, 2666.M, 2696.M, 2699.M, 2700.M, 2709.M, 2710.M, 2711.M, 2712.M, 2713.M, 2714.M, 2715.M, 4053.M, 4054.M, 4055.M, 4056.M, 4057.M, 4058.M, 4059.M, 4060.M, 4061.M, 4062.M, 4064.M, 4065.M, 4066.M, 4067.M, 4068.M, 4069.M, 4070.M, 4071.M, 4072.M, 4073.M, 4074.M, 4075.M.

Elapsoidea semiannulata moebiusi. **Bangaya**: 270.M ; **Djinagué**: 1117.M; **Doussoudiana**: 110.M, TR.0713; **Laminina**: 740.M; **Mamoroubougou**: 3772.M; **Npiébougou**: 1787.M, 1835.M, 1837.M, 1858.M, 1859.M, 1876.M, 3329.M, 3330.M, 3343.M, 3384.M, 3426.M, 3451.M, 4317.M; **Sébékourani**: 143.M, 145.M; **Zamoko**: 164.M, 165.M, 166.M, 167.M, 2582.M, 2591.M, 2629.M.

Eryx muelleri. **Bangaya**: 2.M; **Bouyanga**: 340.M, 341.M, 342.M, 343.M, 370.M, 378.M, 382.M, 386.M, 387.M, 388.M, 405.M, 406.M, 2402.M, 2403.M, 2404.M, 2405.M, 2406.M, 2407.M, 2408.M, 2409.M, 2410.M, 2411.M, 2412.M, 2413.M, 2414.M, 2415.M, 2416.M, 2417.M, 2418.M, 2419.M, 2420.M, 2421.M, 2422.M, 2423.M, 2424.M, 2425.M, 2426.M, 2427.M, 2428.M, 2429.M, 2430.M, 2499.M; **Doro**: 1681.M, 1682.M, 1683.M, 1684.M, 1685.M, 1686.M, 1687.M; **Gaoudel**: 3529.M, 3540.M, 3555.M, 3566.M, 3570.M, 3599.M, 3601.M; **Haoussa-Foulane**: 2274.M; **Koundian**: 3006.M, 3014.M; **Koyretao**: 2332.M, 2333.M, 2338.M, 2339.M, 3506.M, 3516.M, 3520.M, 3525.M ; Léré : 2344.M, 2347.M, 2348.M; **Niamasso**: 1345.M; **Niamou**: 41.M, 56.M, 418.M, 423.M, 425.M, 427.M, 428.M, 430.M, 432.M, 433.M, 434.M, 440.M, 443.M, 444.M, 445.M, 447.M, 448.M, 454.M, 455.M, 460.M, 462.M, 467.M, 471.M, 472.M, 473.M, 495.M, 502.M, 511.M, 512.M, 524.M, 2800.M, 2801.M, 2802.M, 2803.M, 2804.M, 2805.M, 2806.M, 2807.M, 2808.M, 2809.M, 2810.M, 2811.M, 2812.M, 2813.M, 2814.M, 2815.M, 2816.M, 2817.M, 2818.M, 2819.M, 2820.M, 2821.M, 2822.M, 2823.M, 2824.M, 2825.M, 2826.M, 2827.M, 2828.M, 2829.M, 2830.M, 2831.M, 2832.M, 2833.M, 2834.M, 2835.M, 2836.M, 2837.M, 2838.M, 2839.M, 2840.M, 2841.M, 2842.M, 2843.M, 2844.M, 2845.M, 2846.M, 2847.M, 2848.M, 2849.M, 2850.M, 2851.M, 2852.M, 2853.M, 2854.M, 2855.M, 2856.M, 2857.M, 2858.M, 2859.M, 2860.M, 2861.M, 2862.M, 2863.M, 2976.M; **Samé Ouolof**: 1899.M; **Séoulasso**: 1460.M; **Tinjemban**: 1623.M; **Toumboula**: 1259.M, 1283.M, 1300.M, 2793.M.

Gonionotophis granti. **Laminina**: 831. M; **Mamoroubougou**: 4110.M; **Npiébougou**: 3469.M; **Sébékourani**: 998.M.

Graya smithi. **Mamoroubougou**: 1984.M, 1985.M, 1997.M, 2004.M, 2019.M, 3694.M, 3698.M, 3699.M, 3713.M, 3725.M, 3730.M, 3733.M, 3738.M, 3758.M, 3765.M.

Lycophidion albomaculatum. **Djinagué**: 1132.M, 1138.M, 1152.M, 1197.M, 1214.M; **Koundian**: 3020.M, 3022.M, 3028.M; **Niamou**: 2982.M, 2998.M, 2999.M; **Sébékourani**:

146.M, 147.M, 148.M, 922.M, 983.M, 985.M, 986.M, 988.M, 989.M, 996.M, 997.M, 1003.M, 1016.M, 1084.M, 3176.M, 3216.M; **Zamoko**: 155.M, 632.M, 712.M, 713.M, 2590.M, 2667.M.

Lycophidion irroratum. **Mamoroubougou**: 1946.M, 3701.M, 3728.M, 3795.M, 3812.M.

Lycophidion semicinctum. **Laminina**: 739.M, 745.M, 750.M, 2620.M; **Mamoroubougou**: 1981.M, 1983.M, 3700.M, 3756.M, 3757.M, 3792.M, 3825.M, 3840.M, 4301.M; **Npiébougou**: 1849.M, 1860.M, 1882.M, 3348.M, 3379.M, 3436.M, 3463.M, 3489.M, 4002.M; **Titiéna**: 2128.M, 3653.M, 4175.M.

Mehelya crossi. **Laminina**: 760.M, 765.M; **Mamoroubougou**: 177.M, 1978.M, 1992.M, 2008.M, 2018.M, 2031.M, 2055.M, 3723.M, 3739.M, 3764.M; **Npiébougou**: 1776 M, 1783.M, 3392.M; **Sadjouroubougou**: 2520.M; **Sébékourani**: 142.M, 150.M, 869.M, 3153.M; **Titiéna**: 193.M, 2105.M, 2106.M, 2121.M, 2131.M, 2136.M, 3613.M, 3622.M, 3634.M, 3642.M, 3647.M; **Zamoko**: 173.M, 619.M.

Meizodon coronatus. **Bangaya**: 10.M; **Bouyanga**: 2501.M; **Mamoroubougou**: 3702.M; **Sébékourani**: 984.M, 999.M, 1012.M, 1036.M, 1103.M, 1104.M, 1106.M, 3156.M, 3221.M, 3226.M, 3228.M, 3278.M; **Titiéna**: 202.M, 213.M, 2141.M, 2252.M, 3604.M, 4302.M.

Myriopholis adleri. **Sébékourani**: 4260.M.

Myriopholis albiventer. **Doussoudiana**: 5298.M; **Mamoroubougou**: 4288.M, 4320.M, TR.3476, TR.3477.

Myriopholis boueti. **Bamako**: TR.1686; **Bouyanga**: 3304.M, 3305.M, 3306.M, 4181.M, 4182.M, 4183.M, 4184.M, 4185.M, 4186.M; **Djinagué**: 3294.M, 3295.M; **Koundian**: 3296.M ; **Niamou**: 4196.M; **Npiébougou**: 3495.M, 3996.M, 4003.M, 4004.M, 4005.M, 4008.M, 4291.M, 4266.M, 4267.M, 4268.M, 4269.M, 4270.M, 4271.M, 4272.M, 4273.M, 4274.M, 4275.M, 4276.M, 4277.M, 4278.M, 4279.M, 4280.M, 4281.M, 4282.M, 4283.M, 4284.M, 4285.M; **Samé Ouolof**: TR.1685; **Sébékourani**: 144.M, 1100.M, 3283.M, 3284.M, 3285.M, 3286.M, 3287.M, 4261.M, 4262.M, 4263.M; **Zamoko**: 1920.M, 4197.M, 4198.M, 4199.M, 4200.M, 4201.M, 4202.M, 4203.M, 4204.M, 4205.M, 4206.M, 4207.M, 4208.M, 4209.M, 4210.M, 4211.M, 4212.M, 4213.M, 4214.M, 4215.M, 4216.M, 4217.M, 4218.M, 4219.M, 4220.M, 4221.M, 4222.M, 4223.M, 4224.M, 4225.M, 4226.M, 4227.M, 4228.M, 4229.M, 4230.M, 4231.M, 4232.M, 4233.M, 4234.M, 4235.M, 4236.M, 4237.M, 4238.M, 4239.M .4581.M, 4582.M, 4583.M, 4584.M, 4585.M, 4586.M, 4587.M, 4588.M, 4589.M, 4590.M, 4591.M, 4592.M, 4593.M, 4594.M, 4595.M, 4596.M, 4597.M, 4598.M, 4599.M, 4600.M, 4601.M, 4602.M, 4603.M, 4604.M, 4605.M, 4606.M, 4607.M, 4608.M, 4609.M, TR.2520.

Naja katiensis. **Ballabougou**: 1323.M; **Djinagué**: 1108.M, 1125.M, 1157.M, 1187.M; **Doussoudiana**: 77.M, 81.M, 85.M, 93.M, 1764.M, TR.0913, TR.1234, TR.1271; **Laminina**: 764.M, 770.M, 785.M, 787.M, 797.M, 807.M, 829.M, 830.M, 833.M, 845.M, 847.M, TR.0921, TR.0924, TR.1229; **Mamoroubougou**: 176.M, 1987.M, 1996.M, 1998.M, 2000.M, 2001.M, 2005.M, 2010.M, 2013.M, 2015.M, 2020.M, 2023.M, 2030.M, 2040.M, 2041.M, 2042.M, 2051.M, 2052.M, 2054.M, 2061.M, 3690.M, 3695.M, 3697.M, 3703.M, 3705.M, 3706.M, 3707.M, 3708.M, 3709.M, 3710.M, 3714.M, 3715.M, 3726.M, 3729.M, 3736.M, 3742.M, 3743.M, 3752.M, 3755.M, 3760.M, 3763.M, 3768.M, 3769.M, 3770.M, 3773.M, 3775.M, 3778.M, 3779.M, 3787.M, 3815.M, 3821.M, 3822.M, 4299.M; **Npiébougou**: 1778.M, 1784.M, 1785.M, 1794.M, 1797.M, 1798.M, 1801.M, 1807.M, 1811.M, 1812.M, 1813.M, 1818.M, 1820.M, 1821.M, 1825.M, 1826.M, 1832.M, 1844.M, 1848.M, 1851.M, 1855.M, 1857.M, 3311.M, 3314.M, 3315.M, 3316.M, 3317.M, 3318.M, 3319.M, 3320.M, 3321.M, 3322.M, 3325.M, 3326.M, 3328.M, 3332.M, 3334.M, 3335.M, 3336.M, 3338.M, 3339.M, 3342.M, 3344.M, 3345.M, 3347.M, 3350.M, 3352.M, 3353.M, 3354.M, 3355.M, 3358.M, 3359.M, 3360.M, 3363.M, 3364.M, 3365.M, 3366.M, 3367.M, 3371.M, 3372.M, 3377.M, 3378.M, 3381.M, 3383.M, 3387.M, 3389.M, 3390.M, 3391.M, 3393.M, 3394.M, 3395.M, 3396.M, 3397.M, 3399.M, 3400.M, 3401.M, 3403.M, 3405.M, 3406.M, 3407.M, 3408.M, 3409.M, 3410.M, 3411.M, 3412.M, 3413.M, 3418.M, 3421.M, 3424.M, 3429.M, 3430.M, 3431.M, 3433.M, 3438.M, 3439.M, 3440.M, 3444.M, 3445.M, 3460.M, 3464.M, 3468.M, 3472.M, 3475.M, 3483.M, 3488.M, 3497.M, 3994.M; **Sadjouroubougou**: 2503.M, 2504.M, 2505.M, 2506.M, 2507.M; **Sébékourani**: 875.M, 964.M, 991.M, 3152.M, 3167.M, 3172.M, 3206.M, 3258.M; **Titiéna**: 181.M, 182.M, 183.M, 185.M, 186.M, 187.M, 188.M, 189.M, 190.M, 197.M, 203.M, 205.M, 214.M, 216.M, 2071.M, 2076.M, 2079.M, 2080.M, 2095.M, 2110.M, 2111.M, 2113.M, 2139.M, 2158.M, 2179.M, 2182.M, 2183.M, 2191.M, 2206.M, 2212.M, 2219.M, 2223.M, 2243.M, 2248.M, 2251.M, 3603.M, 3605.M, 3608.M, 3620.M, 3624.M, 3625.M, 3626.M, 3627.M, 3628.M, 3629.M, 3630.M, 3631.M, 3632.M, 3633.M, 3635.M, 3636.M, 3643.M, 3648.M, 3651.M, 3654.M, 3655.M, 3656.M, 3658.M, 3661.M, 3662.M, 3664.M, 3667.M, 3676.M, 3677.M, 3678.M, 3679.M, 3680.M, 3682.M, 3686.M; **Zamoko**: 530.M, 531.M, 532.M, 533.M, 534.M, 535.M, 536.M, 537.M, 538.M, 539.M, 540.M, 541.M, 542.M, 543.M, 544.M, 545.M, 546.M, 547.M, 548.M, 549.M, 550.M, 551.M, 552.M, 553.M, 554.M, 555.M, 556.M, 557.M, 558.M, 559.M, 563.M, 569.M, 571.M, 573.M, 576.M, 578.M, 579.M, 580.M, 603.M, 605.M, 618.M, 630.M, 638.M, 639.M, 640.M, 647.M, 681.M, 705.M, 710.M, 2529.M, 2530.M, 2536.M, 2540.M, 2550.M, 2551.M, 2566.M, 2586.M, 2587.M, 2597.M, 2598.M, 2600.M, 2603.M, 2607.M, 2615.M, 2627.M, 2630.M, 2631.M, 2632.M, 2634.M, 2635.M, 2638.M, 2650.M, 2651.M, 2655.M, 2674.M, 2675.M, 2676.M, 2678.M, 2680.M, 2681.M, 2682.M, 2683.M, 2684.M, 2685.M, 2686.M, 2687.M, 2703.M, 2708.M.

Naja melanoleuca. **Bangaya**: 245.M; **Laminina**: 767.M; **Mamoroubougou**: 2027.M, 2048.M, 3716.M; **Npiébougou**: 1782.M, 3312.M, 3420.M, 3476.M; **Sébékourani**: 995.M; **Titiéna**: 2087.M, 2101.M

Naja nigricollis. **Bangaya**: 3.M, 7.M, 29.M, 217.M, 218.M, 235.M, 246.M; **Boussouma**: 1738.M, 1739.M, 1740.M; **Koundian**: 60.M, 62.M, 3026.M, 3029.M, 3031.M, 3037.M; **Mamoroubougou**: 1990.M, 3727.M; **Niamasso**: 1342.M; **Niamou**: 421.M, 2981.M, 2989.M, 2990.M; **Sébékourani**: 897.M, 3173.M, 3185.M, 3191.M, 3192.M, 3198.M; **Séoulasso**: 1390.M, 3132.M; **Toya**: 1642.M, 2298.M, 2302.M, 2312.M; **Zamoko**: 565.M, 584.M, 609.M, 2541.M, 2614.M.

Naja senegalensis. **Ballabougou**: 2353.M, 2354.M; **Bangaya**: 238.M; **Djinagué**: 1179.M, 1181.M; **Doussoudiana**: 103.M; **Koundian**: 2368.M; **Laminina**: 805.M, TR.1273; **Mamoroubougou**: 1977.M, 2003.M, 2017.M; **Npiébougou**: 1796.M, 3419.M; **Sadjouroubougou**: 2352.M; **Saré-Soma**: 1591.M; **Sébékourani**: 878.M, 957.M; **Titiéna**: 184.M, 2102.M, 2109.M, 2118.M, 2145.M, 2186.M, 3606.M, 3617.M, 3618.M, 3683.M; **Zamoko**: 156.M, 581.M, 2349.M, 2350.M, 2351.M.

Philothamnus irregularis. **Doussoudiana**: 75.M, 78.M, 87.M, 89.M, 91.M, 114.M, 1756.M, 1774.M, TR.1305; **Laminina**:

759.M, 771.M, 772.M, 774.M, 777.M, 783.M, 821.M, 822.M, TR.0925, TR.1275, TR.1277, TR.1279, TR.1308, TR.1310, TR.1311, TR.1332; **Niakoni**: TR.0927; **Npiébougou**: 1775.M, 1847.M, 3309.M, 3349.M, 3414; **Sébékourani**: 980.M, 982.M, 993.M, 994.M, 3162.M, 3196.M, 3211.M, 3233.M; **Titiéna**: 2078.M, 2098.M, 2224.M, 3607.M.

Philothamnus semivariegatus smithi. **Doussoudiana**: 1766.M, 1767.M; **Laminina**: 751.M; **Niamou**: 1918.M.

Polemon neuwiedi. **Mamoroubougou** 1935.M, 4159.M, 4162.M.

Prosymna collaris. **Topokhoné**: 129.M.

Prosymna greigerti. **Bangaya**: 289.M; **Npiébougou**: 4314.M; **Djinagué**: 1209.M; **Koundian**: 2372.M; **Laminina**: 741.M, 747.M, 752.M, 756.M, 823.M, 854.M; **Mamoroubougou**: 1933.M, 1938.M, 1982.M, 3712.M, 3719.M, 3737.M, 3753.M, 3805.M, 3832.M, 3835.M, 3851.M, 4160.M, 4296.M, 4297.M, 4300.M; **Niamou**: 1922.M; **Npiébougou**: 1822.M, 3323.M, 3435.M, 3461.M, 3471.M, 3481.M; **Sébékourani**: 149.M, 152.M, 967.M, 981.M, 992.M, 3261.M, 3269.M; **Titiéna**: 1925.M, 1926.M, 1927.M, 1929.M, 1931.M, 4172.M; **Toumboula**: 1235.M; **Zamoko**: 154.M, 1919.M.

Psammophis elegans. **Bangaya**: 13.M; **Bouyanga**: 52.M; **Doussoudiana**: 82.M, 88.M, 96.M, 100.M, 117.M, 118.M; **Kinani**: 1554.M, 1568.M, 1572.M, 1573.M, 1577.M; **Koundian**: 2367.M, 3007.M, 3015.M, 3017.M, 3024.M, 3036.M, 3040.M, 3041.M; **Laminina**: 779.M, 780.M, 793.M, 803.M, 826.M, TR.0923, TR.1226, TR.1228; **Mamoroubougou**: 178.M, 2012.M, 2025.M, 3711.M, 3735.M, 3741.M, 3837.M; **Npiébougou**: 1786.M, 1788.M, 1791.M, 1803.M, 1805.M, 1828.M, 1830.M, 1836.M, 1839.M, 1841.M, 1879.M, 1880.M, 3341.M, 3423.M, 3494.M; **Sadjouroubougou**: 2508.M, 2509.M, 2510.M, 2511.M; **Samé Ouolof**: 3045.M, 3062.M; **Saré-Soma**: 1608.M; **Sébékourani**: 883.M, 928.M, 1062.M, 3195.M, 3209.M, 3214.M; **Séoulasso**: 1398.M, 1427.M, 1428.M, 1429.M, 1445.M, 1463.M, 1466.M, 1477.M, 3083.M, 3097.M, 3100.M, 3103.M, 3145.M, 3149.M; **Ténintou**: TR.0688; **Titiéna**: 2160.M, 3638.M, 3665.M; **Zamoko**: 577.M, 582.M, 587.M, 620.M, 650.M, 2588.M, 2611.M, 2626.M, 2679.M.

Psammophis lineatus. **Mamoroubougou**: 3754.M, 3811.M.

Psammophis philippsi. **Laminina**: 822.M.

Psammophis praeornatus. **Mamoroubougou**: 3838.M, 3845.M; **Niamou**: 2985.M; **Npiébougou**: 3374.M; **Sadjouroubougou**: 1317.M; **Samé Ouolof**: 1915.M; **Sébékourani**: 3229.M; **Séoulasso**: 1358.M, 1392.M, 1403.M, 1446.M, 1501.M, 1522.M, 3096.M; **Titiéna**: 2096.M, 2107.M, 2127.M, 2200.M, 2209.M, 3637.M; **Zamoko**: 2545.M, 2567.M, 2570.M, 2636.M, 2656.M, 2662.M, 2663.M, 2673.M.

Psammophis schokari. **Gaoudel**: 1545.M; **Tinjemban**: 1622.M, 1624.M, 2281.M.

Psammophis* aff. *sibilans. **Agoudoud**: 1677.M, 1678.M; **Ballabougou**: 1320.M, 1321.M, 1322.M, 2523.M, 2524.M; **Bangaya**: 4.M, 6.M, 8.M, 16.M, 24.M, 220.M, 222.M, 230.M, 247.M, 248.M, 249.M, 250.M, 252.M, 262.M, 267.M, 268.M, 274.M, 287.M; **Boussouma**: 1724.M, 1725.M, 1726.M, 1727.M, 1728.M, 1729.M, 1730.M, 1731.M, 1732.M, 1733.M, 1734.M, 1735.M, 1736.M; **Bouyanga**: 344.M, 345.M, 355.M, 360.M, 372.M, 373.M, 375.M, 379.M, 392.M, 393.M, 394.M, 395.M, 398.M, 404.M, 411.M, 2375.M, 2377.M, 2378.M, 2379.M, 2380.M, 2383.M, 2386.M, 2389.M, 2390.M, 2391.M, 2392.M, 2393.M, 2394.M, 2395.M, 2396.M, 2397.M, 2398.M, 2399.M, 2400.M, 2401.M, TR.2871; **Djinagué**: 1110.M, 1113.M, 1122.M, 1129.M, 1130.M, 1139.M, 1144.M, 1155.M, 1159.M, 1164.M, 1165.M, 1167.M, 1170.M, 1171.M, 1172.M, 1175.M, 1182.M, 1193.M, 1199.M, 1202.M, 1211.M, 1212.M, 1213.M, 1215.M, 1217.M, 1222.M, 1223.M; **Donguiba**: 3308.M; **Doussoudiana**: 83.M, 101.M, 108.M, 115.M, 1755.M, 1757.M, 1770.M, TR.0720, TR.1237, TR.1238, TR.1268, TR.1272, TR.1306; **Gaoudel**: 1530.M, 1533.M, 1534.M, 1537.M, 1543.M, 1556.M, 3530.M, 3535.M, 3537.M, 3539.M, 3542.M, 3543.M, 3544.M, 3546.M, 3550.M, 3551.M, 3552.M, 3553.M, 3556.M, 3557.M, 3562.M, 3563.M, 3565.M, 3568.M, 3574.M, 3582.M, 3590.M, 3597.M, 3598.M, 3600.M, 3602.M; **Haoussa-Foulane**: 2270.M, 2272.M; **Kinani**: 1549.M, 1550.M, 1553.M, 1557.M, 1558.M, 1560.M, 1561.M, 1562.M, 1563.M, 1565.M, 1566.M, 1567.M, 1569.M, 1574.M, 1575.M, 1576.M, 1580.M; **Koundian**: 63.M, 3002.M, 3003.M, 3004.M, 3005.M, 3008.M, 3009.M, 3011.M, 3013.M, 3016.M, 3023.M, 3030.M, 3033.M, 3038.M, 3039.M; **Koyretao**: 1618.M, 3499.M; **Laminina**: 773.M, 781.M, 801.M, 802.M, 818.M, 825.M, 827.M, 832.M, 838.M, 839.M, 852.M, 2623.M, TR.1312, TR.1313; Léré : 2343.M, 2345.M; **Mamoroubougou**: 1999.M, 2024.M, 2053.M, 2062.M, 2065.M, 3718.M, 3803.M, 3804.M, 3810.M, 3814.M, 3852.M, 3854.M, 3855.M; **Niakoni**: TR.0886, TR.0926, TR.1298; **Niamasso**: 1324.M, 1325.M, 1326.M, 1327.M, 1328.M, 1329.M, 1331.M, 1332.M, 1333.M, 1334.M, 1335.M, 1336.M, 1337.M, 1338.M, 1339.M, 1340.M; **Niamou**: 34.M, 42.M, 58.M, 59.M, 419.M, 429.M, 431.M, 463.M, 468.M, 469.M, 478.M, 479.M, 480.M, 488.M, 489.M, 492.M, 499.M, 513.M, 514.M, 515.M, 516.M, 2864.M, 2865.M, 2866.M, 2868.M, 2869.M, 2870.M, 2871.M, 2872.M, 2873.M, 2875.M, 2876.M, 2877.M, 2878.M, 2879.M, 2880.M, 2881.M, 2882.M, 2883.M, 2884.M, 2885.M, 2886.M, 2887.M, 2888.M, 2889.M, 2890.M, 2891.M, 2893.M, 2894.M, 2895.M, 2896.M, 2897.M, 2898.M, 2899.M, 2900.M, 2901.M, 2902.M, 2903.M, 2904.M, 2905.M, 2906.M, 2907.M, 2908.M, 2909.M, 2910.M, 2911.M, 2912.M, 2913.M, 2914.M, 2915.M, 2916.M, 2917.M, 2918.M, 2919.M, 2920.M, 2921.M, 2922.M, 2975.M, 2992.M, TR.0256; **Npiébougou**: 1777.M, 1793.M, 1802.M, 1824.M, 1827.M, 1845.M, 1846.M, 1863.M, 1865.M, 1866.M, 1871.M, 1872.M, 3310.M, 3331.M, 3333.M, 3340.M, 3382.M, 3402.M, 3404.M, 3432.M, 3437.M, 3442.M, 3452.M; **Samé Ouolof**: 1743.M, 1744.M, 1745.M, 1746.M, 1747.M, 1750.M, 1751.M, 1897.M, 1898.M, 1903.M, 1906.M, 1910.M, 1911.M, 1912.M, 3044.M, 3046.M, 3047.M, 3048.M, 3049.M, 3050.M, 3051.M, 3052.M, 3053.M, 3054.M, 3055.M, 3056.M, 3057.M, 3058.M, 3059.M, 3060.M, 3063.M, 3065.M, 3066.M, 3067.M, 3068.M, 3070.M, 3072.M, 3073.M, 3075.M, 3076.M, 3079.M, 3080.M, 3081.M; **Saré-Soma**: 1586.M, 1587.M, 1588.M, 1589.M, 1590.M, 1592.M, 1593.M, 1595.M, 1596.M, 1597.M, 1598.M, 1599.M, 1600.M, 1601.M, 1602.M, 1603.M, 1604.M, 1605.M, 1606.M, 1607.M, 1609.M, 1610.M, 1611.M, 1612.M, 1613.M, 1615.M, 1616.M; **Sébékourani**: 863.M, 871.M, 881.M, 884.M, 953.M, 966.M, 1007.M, 1021.M, 1022.M, 1026.M, 1029.M, 1044.M, 1051.M, 1054.M, 1055.M, 1061.M, 1064.M, 3154.M, 3157.M, 3160.M, 3165.M, 3170.M, 3174.M, 3178.M, 3184.M, 3186.M, 3187.M, 3188.M, 3190.M, 3193.M, 3194.M, 3197.M, 3205.M, 3207.M, 3213.M, 3215.M, 3219.M, 3220.M, 3223.M, 3234.M, 3238.M, 3240.M, 3242.M, 3244.M, 3250.M, 3251.M, 3252.M, 3254.M, 3255.M, 3256.M, 3257.M, 3259.M, 3268.M, 3271.M, 3275.M, 3277.M, 3291.M; **Séoulasso**: 1348.M, 1354.M, 1364.M, 1381.M, 1382.M, 1394.M, 1400.M, 1424.M, 1425.M, 1430.M, 1458.M, 1475.M, 1485.M, 1494.M, 1495.M, 1497.M, 1499.M, 1511.M, 1512.M, 1513.M, 1515.M, 1516.M, 1716.M, 1717.M, 1718.M, 1719.M, 1720.M, 1721.M, 1722.M, 3082.M, 3084.M, 3085.M, 3087.M,

3088.M, 3089.M, 3090.M, 3091.M, 3092.M, 3093.M, 3095.M, 3098.M, 3099.M, 3101.M, 3104.M, 3105.M, 3106.M, 3108.M, 3109.M, 3110.M, 3112.M, 3113.M, 3114.M, 3115.M, 3116.M, 3117.M, 3118.M, 3119.M, 3120.M, 3121.M, 3122.M, 3123.M, 3124.M, 3125.M, 3126.M, 3127.M, 3129.M, 3131.M, 3133.M, 3135.M, 3137.M, 3138.M, 3139.M, 3140.M, 3141.M, 3142.M, 3143.M, 3144.M, 3146.M, 3147.M, 3148.M, 3150.M, 3151.M; **Tacharane**: 1885.M, 1886.M, 1887.M, 1888.M; **Tinjemban**: 1620.M, 1633.M, 2285.M; **Titiéna**: 192.M, 196.M, 199.M, 206.M, 209.M, 2068.M, 2070.M, 2072.M, 2086.M, 2090.M, 2091.M, 2097.M, 2126.M, 2129.M, 2140.M, 2142.M, 2143.M, 2146.M, 2148.M, 2149.M, 2152.M, 2161.M, 2163.M, 2169.M, 2172.M, 2177.M, 2185.M, 2188.M, 2190.M, 2196.M, 2197.M, 2210.M, 2213.M, 2216.M, 2222.M, 2228.M, 2231.M, 2238.M, 2239.M, 2244.M, 2247.M, 2249.M, 2259.M, 2260.M, 2261.M, 2265.M; **Toumboula**: 1264.M, 1315.M, 2789.M, 2792.M, 2795.M; **Toya**: 1638.M, 1639.M, 1640.M, 1641.M, 1643.M, 1644.M, 1645.M, 1646.M, 1647.M, 1648.M, 1649.M, 1650.M, 1651.M, 1652.M, 1653.M, 1654.M, 1655.M, 1656.M, 1657.M, 1658.M, 1659.M, 1660.M, 1661.M, 1662.M, 1663.M, 1664.M, 1665.M, 1666.M, 1667.M, 1669.M, 1670.M, 1671.M, 1672.M, 1673.M, 1674.M, 1675.M, 1676.M, 2286.M, 2287.M, 2288.M, 2289.M, 2290.M, 2291.M, 2292.M, 2293.M, 2294.M, 2296.M, 2297.M, 2299.M, 2300.M, 2301.M, 2303.M, 2304.M, 2305.M, 2306.M, 2307.M, 2308.M, 2309.M, 2310.M, 2311.M, 2313.M, 2314.M, 2315.M, 2316.M, 2317.M, 2318.M; **Zamoko**: 560.M, 561.M, 562.M, 572.M, 575.M, 592.M, 601.M, 606.M, 628.M, 644.M, 659.M, 700.M, 733.M, 734.M, 2543.M, 2544.M, 2546.M, 2553.M, 2556.M, 2560.M, 2561.M, 2565.M, 2571.M, 2573.M, 2578.M, 2579.M, 2583.M, 2584.M, 2589.M, 2604.M, 2610.M, 2612.M, 2617.M, 2618.M, 2628.M, 2637.M, 2639.M, 2644.M, 2652.M, 2660.M, 2661.M, 2668.M, 2669.M, 2670.M, 2671.M, 2677.M, 2688.M, 2689.M, 2695.M, 2697.M, 2698.M, 2704.M, 2705.M, 2716.M, 2717.M, 2718.M.

Python regius. **Ballabougou**: 2522.M; **Djinagué**: 1115.M, 1135.M, 1218.M; **Doussoudiana**: 74.M, 102.M, 113.M, 120.M, 1754.M, 1759.M, 1772.M, TR.0903, TR.1269, TR.1300; **Koundian**: 2365.M; **Laminina**: 768.M, 798.M, 809.M, 814.M, 815.M, 817.M, TR.1278; **Niakoni**: TR.1281; **Niamou** : 442.M; **Sadjouroubougou**: 2502.M; **Sébékourani**: 860.M, 861.M, 862.M, 866.M, 873.M, 879.M, 886.M, 896.M, 900.M, 903.M, 912.M, 931.M, 971.M, 1033.M, 1045.M, 3164.M, 3265.M, 3273.M; **Titiéna**: 2117.M, 2132.M, 2162.M, 2214.M, 2221.M, 3616.M, 3619.M, 3671.M; **Zamoko**: 586.M, 596.M, 635.M, 2624.M.

Python sebae. **Bangaya**: 22.M; **Boussouma**: 1737.M; **Bouyanga**: 401.M ; **Djinagué**: 1189.M ; **Laminina**: 758.M, 769.M, 808.M; **Niamou**: 417.M, 424.M, 437.M, 2984.M, 2992.M; **Npiébougou**: 3368.M; **Samé Ouolof**: 1752.M; **Sébékourani**: 865.M, 885.M, 890.M, 891.M, 937.M, 1048.M, 3272.M; **Titiéna**: 2089.M; **Toumboula**: 1257.M.

Rhagerhis moilensis. **Gaoudel**: 1538.M, 1541.M, 1544.M, 3533.M, 3558.M; **Gogui** (10 km S): 3307.M; **Haoussa-Foulane**: 2271.M; **Koyretao**: 3501.M.

Rhamphiophis oxyrhynchus. **Bangaya**: 5.M; **Bouyanga**: 2376.M, 2381.M, 2385.M, 2388.M; **Djinagué**: 1220.M; **Doussoudiana**: 76.M, 109.M, 1762.M, TR.0719, TR.0914, TR.1302; **Laminina**: 789.M, 804.M, TR.0648; **Mamoroubougou**: 3828.M, 3834.M, 3849.M; **Niakoni**: TR.0928, TR.1297; **Niamou**: 497.M, 2991.M, 2996.M; **Npiébougou**: 1776.M, 1781.M, 1790.M, 1792.M, 1795.M, 1804.M, 1831.M, 1838.M, 1853.M, 1867.M, 1878.M, 1881.M, 3369.M, 3388.M, 3415.M, 3422.M, 3427.M; **Sébékourani**: 958.M, 972.M, 987.M, 1006.M, 1028.M, 1030.M, 3159.M, 3181.M, 3183.M; **Séoulasso**: 1372.M, 1380.M, 1412.M, 1450.M, 1457.M, 1465.M, 1723.M, 3102.M, 3107.M, 3111.M, 3130.M, 3134.M; **Titiéna**: 194.M, 198.M, 1928.M, 2103.M, 2108.M, 2115.M, 2116.M, 2133.M, 2138.M, 2155.M, 2175.M, 2184.M, 2192.M, 2195.M, 2205.M, 2207.M, 2220.M, 2225.M, 2230.M, 2232.M, 2233.M, 2237.M, 2255.M, 3639.M, 3640.M, 3645.M, 3660.M, 4022.M; **Zamoko**: 588.M, 643.M, 726.M, 2531.M, 2549.M, 2592.M, 2599.M, 2701.M, 2706.M.

Rhinoguinea magna. **Mamoroubougou**: 1956.M, 4142.M, 4143.M, 4144.M, 4318.M, 4319.M, TR.2501, TR.2822, TR.2823, TR.2824, TR.2825, TR.3478, TR.3479, TR.3480, TR.3481, TR.3482.

Rhinoleptus koniagui. **Djinagué**: 4187.M; **Koundian**: 2374.M; **Laminina**: 749.M, 753.M, 828.M; **Npiébougou**: 3998.M, 4177.M, 4178.M, 4179.M, 4180.M, 4287.M.

Spalerosophis diadema. **Gaoudel**: 3528.M, 3571.M; **Koyretao**: 2325.M, 2336.M, 3508.M, 3515.M, 3522.M; **Toya**: 1668.M.

Telescopus tripolitanus. **Kinani**: 1551.M, 1571.M, 1578.M; **Toumboula**: 1229.M, 2788.M, 2790.M, 2791.M, 2798.M.

Telescopus variegatus. **Koundian**: 3027.M; **Mamoroubougou**: 3721.M, 3833.M; **Zamoko**: 169.M, 629.M, 2613.M, 2653.M; **Zamoko**: 168.M.

Tricheilostoma bicolor. **Doussoudiana**: 3280.M, 3281.M, 3282.M, TR.1323; **Laminina**: 842.M; **Mamoroubougou**: 1934.M, 1943.M, 1945.M, 1948.M, 1949.M, 1950.M, 1954.M, 1958.M, 1962.M, 1963.M, 1966.M, 1968.M, 1969.M, 1970.M, 1971.M, 1972.M, 1973.M, 1974.M, 1975.M, 4169.M, 4289.M, 4610.M, 4611.M, 4612.M, 4613.M, 4614.M, 4615.M, 4616.M, 4617.M, 4618.M, 4619.M, 4620.M, 4621.M, 4622.M, 4623.M, 4624.M, 4625.M, 4626.M, 4627.M, 4628.M, 4629.M, 4630.M, 4631.M, 4632.M, 4633.M, 4634.M, 4635.M, 4636.M, 4637.M, 4638.M, 4639.M, 4640.M, 4641.M, 4642.M, 4643.M, 4644.M, 4645.M, 4646.M, 4647.M, 4648.M, 4649.M, 4650.M, 4651.M, 4652.M, 4653.M, 4654.M, 4655.M, 4656.M, 4657.M, 4658.M, 4659.M, 4660.M, 4661.M, 4662.M, 4663.M, 4664.M, 4665.M, 4666.M, 4667.M, 4668.M, 4669.M, 4670.M, 4671.M, 4672.M, 4673.M, 4674.M, 4675.M, 4676.M, 4677.M, 4678.M, 4679.M, 4680.M, 4681.M, 4682.M, 4683.M, 4684.M, 4685.M, 4686.M, 4687.M, 4688.M, 4689.M, 4690.M, 4691.M, 4692.M, 4693.M, 4694.M, 4695.M, 4696.M, 4697.M, 4698.M, 4699.M, 4700.M, 4701.M, 4702.M, 4703.M, 4704.M, 4705.M, 4706.M, 4707.M, 4708.M, 4709.M, 4710.M, 4711.M, 4712.M, 4713.M, 4714.M, 4715.M, 4716.M, 4717.M, 4718.M, 4719.M, 4720.M, 4721.M, 4722.M, 4723.M, 4724.M, 4725.M, 4726.M, 4727.M, 4728.M, 4729.M, 4730.M, 4731.M, 4732.M, 4733.M, 4734.M, 4735.M, 4736.M, 4737.M, 4738.M, 4739.M, 4740.M, 4741.M, 4742.M, 4743.M, 4744.M, 4745.M, 4746.M, 4747.M, 4748.M, 4749.M, 4750.M, 4751.M, 4752.M, 4753.M, 4754.M, 4755.M, 4756.M, 4757.M, 4758.M, 4759.M, 4760.M, 4761.M, 4762.M, 4763.M, 4764.M, 4765.M, 4766.M, 4767.M, 4768.M, 4769.M, 4770.M, 4771.M, 4772.M, 4773.M, 4774.M, 4775.M, 4776.M, 4777.M, 4778.M, 4779.M, 4780.M, 4781.M, 4782.M, 4783.M, 4784.M, 4785.M, 4786.M, 4787.M, 4788.M, 4789.M, 4790.M, 4791.M, 4792.M, 4793.M, 4794.M, 4795.M, 4796.M, 4797.M, 4798.M, 4799.M, 4800.M, 4801.M, 4802.M, 4803.M, 4804.M, 4805.M, 4806.M, 4807.M, 4808.M, 4809.M,, 4810.M, 4811.M, 4812.M, 4813.M, 4814.M, 4815.M, 4816.M, 4817.M, 4818.M, 4819.M, 4820.M, 4821.M, 4822.M, 4823.M, 4824.M, 4825.M, 4826.M, 4827.M, 4828.M, 4829.M, 4830.M, 4831.M, 4832.M, 4833.M,

4834.M , 4835.M , 4836.M , 4837.M , 4838.M , 4839.M , 4840.M , 4841.M , 4842.M , 4843.M , 4844.M , 4845.M , 4846.M , 4847.M , 4848.M , 4849.M , 4850.M , 4851.M , 4852.M , 4853.M , 4854.M , 4855.M , 4856.M , 4857.M , 4858.M , 4859.M , 4860.M , 4861.M , 4862.M , 4863.M , 4864.M , 4865.M , 4866.M , 4867.M , 4868.M , 4869.M , 4870.M , 4871.M , 4872.M , 4873.M , 4874.M , 4875.M , 4876.M , 4877.M , 4878.M , 4879.M , 4880.M , 4881.M , 4882.M , 4883.M , 4884.M , 4885.M , 4886.M , 4887.M , 4888.M , 4889.M , 4890.M , 4891.M , 4892.M , 4893.M , 4894.M , 4895.M , 4896.M , 4897.M , 4898.M , 4899.M , 4900.M , 4901.M , 4902.M , 4903.M , 4904.M , 4905.M , 4906.M , 4907.M , 4908.M , 4909.M , 4910.M , 4911.M , 4912.M , 4913.M , 4914.M , 4915.M , 4916.M , 4917.M , 4918.M , 4919.M , 4920.M , 4921.M , 4922.M , 4923.M , 4924.M , 4925.M , 4926.M , 4927.M , 4928.M , 4929.M , 4930.M , 4931.M , 4932.M , 4933.M , 4934.M , 4935.M , 4936.M , 4937.M , 4938.M , 4939.M , 4940.M , 4941.M , 4942.M , 4943.M , 4944.M , 4945.M , 4946.M , 4947.M , 4948.M , 4949.M , 4950.M , 4951.M , 4952.M , 4953.M , 4954.M , 4955.M , 4956.M , 4957.M , 4958.M , 4959.M , 4960.M , 4961.M , 4962.M , 4963.M , 4964.M , 4965.M , 4966.M , 4967.M , 4968.M , 4969.M , 4970.M , 4971.M , 4972.M , 4973.M , 4974.M , 4975.M , 4976.M , 4977.M , 4978.M , 4979.M , 4980.M , 4981.M , 4982.M , 4983.M , 4984.M , 4985.M , 4986.M , 4987.M , 4988.M , 4989.M , 4990.M , 4991.M , 4992.M , 4993.M , 4994.M , 4995.M , 4996.M , 4997.M , 4998.M , 4999.M , 5000.M , 5001.M , 5002.M , 5003.M , 5004.M , 5005.M , 5006.M , 5007.M , 5008.M , 5009.M ,, 5010.M , 5011.M , 5012.M , 5013.M , 5014.M , 5015.M , 5016.M , 5017.M , 5018.M , 5019.M , 5020.M , 5021.M , 5022.M , 5023.M , 5024.M , 5025.M , 5026.M , 5027.M , 5028.M , 5029.M , 5030.M , 5031.M , 5032.M , 5033.M , 5034.M , 5035.M , 5036.M , 5037.M , 5038.M , 5039.M , 5040.M , 5041.M , 5042.M , 5043.M , 5044.M , 5045.M , 5046.M , 5047.M , 5048.M , 5049.M , 5050.M , 5051.M , 5052.M , 5053.M , 5054.M , 5055.M , 5056.M , 5057.M , 5058.M , 5059.M , 5060.M , 5061.M , 5062.M , 5063.M , 5064.M , 5065.M , 5066.M , 5067.M , 5068.M , 5069.M , 5070.M , 5071.M , 5072.M , 5073.M , 5074.M , 5075.M , 5076.M , 5077.M , 5078.M , 5079.M , 5080.M , 5081.M , 5082.M , 5083.M , 5084.M , 5085.M , 5086.M , 5087.M , 5088.M , 5089.M , 5090.M , 5091.M , 5092.M , 5093.M , 5094.M , 5095.M , 5096.M , 5097.M , 5098.M , 5099.M , 5100.M , 5101.M , 5102.M , 5103.M , 5104.M , 5105.M , 5106.M , 5107.M , 5108.M , 5109.M , 5110.M , 5111.M , 5112.M , 5113.M , 5114.M , 5115.M , 5116.M , 5117.M , 5118.M , 5119.M , 5120.M , 5121.M , 5122.M , 5123.M , 5124.M , 5125.M , 5126.M , 5127.M , 5128.M , 5129.M , 5130.M , 5131.M , 5132.M , 5133.M , 5134.M , 5135.M , 5136.M , 5137.M , 5138.M , 5139.M , 5140.M , 5141.M , 5142.M , 5143.M , 5144.M , 5145.M , 5146.M , 5147.M , 5148.M , 5149.M , 5150.M , 5151.M , 5152.M , 5153.M , 5154.M , 5155.M , 5156.M , 5157.M , 5158.M , 5159.M , 5160.M , 5161.M , 5162.M , 5163.M , 5164.M , 5165.M , 5166.M , 5167.M , 5168.M , 5169.M , 5170.M , 5171.M , 5172.M , 5173.M , 5174.M , 5175.M , 5176.M , 5177.M , 5178.M , 5179.M , 5180.M , 5181.M , 5182.M , 5183.M , 5184.M , 5185.M , 5186.M , 5187.M , 5188.M , 5189.M , 5190.M , 5191.M , 5192.M , 5193.M , 5194.M , 5195.M , 5196.M , 5197.M , 5198.M , 5199.M , 5200.M , 5201.M , 5202.M , 5203.M , 5204.M , 5205.M , 5206.M , 5207.M , 5208.M , 5209.M , 5210.M , 5211.M , 5212.M , 5213.M , 5214.M , 5215.M , 5216.M , 5217.M , 5218.M , 5219.M , 5220.M , 5221.M , 5222.M , 5223.M , 5224.M , 5225.M , 5226.M , 5227.M , 5228.M , 5229.M , 5230.M , 5231.M , 5232.M , 5233.M , 5234.M , 5235.M , 5236.M , 5237.M , 5238.M , 5239.M , 5240.M , 5241.M , 5242.M , 5243.M , 5244.M , 5245.M , 5246.M , 5247.M , 5248.M , 5249.M , 5250.M , 5251.M , 5252.M , 5253.M , 5254.M , 5255.M , 5256.M , 5257.M , 5258.M , 5259.M , 5260.M , 5261.M , 5262.M , 5263.M , 5264.M , 5265.M , 5266.M , 5267.M , 5268.M , 5269.M , 5270.M , 5271.M , 5272.M , 5273.M , 5274.M , 5275.M , 5276.M , 5277.M , 5278.M , 5279.M , 5280.M , 5281.M , 5282.M , 5283.M , 5284.M , 5285.M , 5286.M , 5287.M , 5288.M , 5289.M , 5290.M , 5291.M , 5292.M , 5293.M , 5294.M , 5295.M , 5296.M , 5297.M .,TR.2846,TR.2847; **Titiéna**: 4173.M , 4174.M ; **Niamou**: 140.M , 141.M , 4265.M ; **Npiébougou**: 4188.M , 4189.M , 4190.M , 4191.M , 4192.M , 4193.M , 4290.M ; **Sébékourani**: 3288.M , 3289.M , 3297.M , 3298.M , 3299.M , 3300.M , 3301.M , 3302.M , 3303.M ; **Zamoko**: 1917.M , 4240.M , 4241.M , 4242.M , 4243.M , 4244.M , 4245.M , 4246.M , 4247.M , 4248.M , 4249.M , 4250.M , 4251.M , 4252.M , 4253.M , 4254.M , 4255.M , 4256.M , 4257.M , 4258.M , 4259.M , 4501.M , 4502.M , 4503.M , 4504.M , 4505.M , 4506.M , 4507.M , 4508.M , 4509.M , 4510.M , 4511.M , 4512.M , 4513.M , 4514.M , 4515.M , 4516.M , 4517.M , 4518.M , 4519.M , 4520.M , 4521.M , 4522.M , 4523.M , 4524.M , 4525.M , 4526.M , 4527.M , 4528.M , 4529.M , 4530.M , 4531.M , 4532.M , 4533.M , 4534.M , 4535.M , 4536.M , 4537.M , 4538.M , 4539.M , 4540.M , 4541.M , 4542.M , 4543.M , 4544.M , 4545.M , 4546.M , 4547.M , 4548.M , 4549.M , 4550.M , 4551.M , 4552.M , 4553.M , 4554.M , 4555.M , 4556.M , 4557.M , 4558.M , 4559.M , 4560.M , 4561.M , 4562.M , 4563.M , 4564.M , 4565.M , 4566.M , 4567.M , 4568.M , 4569.M , 4570.M , 4571.M , 4572.M , 4573.M , 4574.M , 4575.M , 4576.M , 4577.M , 4578.M , 4579.M , 4580.M .

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Additional records of the Arabian Sand Cat *Felis margarita harrisoni* (Hemmer, Grubb & Groves, 1976) (Carnivora: Felidae) in Iraq

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Abstract. The Arabian Sand Cat *Felis margarita harrisoni* is a rare nocturnal feline associated with desert and arid steppes. The species has been recently recorded to Iraq from three specimens by Mohammad et al. (2013). However, its current status and population trends in Iraq still unknown. In 2014 and 2015, additional records with first photographic evidence were made. These new records confirm the resident occurrence of this species in Iraq.

Key words. Arabian Sand Cat, Carnivora, Felidae, Iraq, wild mammals.

INTRODUCTION

Sand Cat *Felis margarita* is a cryptic nocturnal feline well adapted to desert and arid plains. It is similar to Wild Cat *Felis silvestris* but noticeably smaller and paler. The head is rather flat with broad and large ears that lack the apical dark tufts in their tips. The vibrissae are white; the limbs are of medium length and marked with by at least two pronounced black elbow bars and with broad paws; the palms and soles are covered with a dense mat of long wavy hair which conceals the pads. The pelage is soft and dense with abundant soft woolly underfur, and the coloration is strikingly pallid with a pale sandy isabelline tint in the back. The face is marked with dark brownish stripes from the anterior canthus of each eye backwards across the cheeks. The tail is tipped with black and has two or three subterminal black bars (Harrison & Bates 1991).
Four subspecies have been described: *F. m. margarita* in North Africa; *F. m. harrisoni* in Arabia; *F. m. thinobia* in Central Asia; and *F. m. scheffeli* in Pakistan (Sliwa 2013; Banfield et al. 2014). The Arabian Sand Cat *F. m. harrisoni* is known from many localities across the Middle East, but its current status and distribution across the Arabian Peninsula are not known in detail. Its population size is uncertain; it seems to be declining but at an unknown rate (Mallon & Budd 2011). It was recorded from Oman (type locality), Yemen, Saudi Arabia, United Arab Emirates, Qatar, Kuwait, Jordan, Syria, Israel, Sinai, and Iran (Harrison & Bates 1991; Cunningham 2002; Serra et al. 2007; Strauss et al. 2007; Sher Shah & Cunningham 2008; Mallon & Budd 2011; Banfield et al. 2014; Ghadirian et al. 2016).

The status of the Arabian Sand Cat in Iraq is still uncertain. It is a cryptic and rarely seen feline, confined to vegetated sandy desert, sand dunes, sand/gravel steppes, and rocky valleys (wadies) of south and western Iraq (Al-Sheikhly et al. 2015). Iraq's first record was based on three specimens (two males and one female). One of the males and the female were found alive at a private nursery in Baghdad on 27 January 2012. They were collected from a desert area situated in the west of Al-Najaf city in Al-Najaf province. A third specimen (another male) was a mounted skin which appeared to be has been trapped from Al-Jufaira oasis in the desert of Al-Najaf province in November 2012 (Mohammad et al. 2013).

NEW RECORDS

Three records (four specimens: three adult males and a juvenile female) were made (Table 1). On 28 February 2014, an adult male and juvenile female were presented at the local animal market in Baghdad. They were collected from desert area near Al-Shabakah (Shbecha) in Al-Najaf Province (Fig.1). Another adult male was presented at the local animal market in Baghdad on 7 March 2014. It was trapped near Takhadid (*c*.4 0 km) to the southwest of Nigr'at Al-Salman in Al-Muthana Province (a note on this record is found in Al-Sheikhly et al. 2015). On 14 April 2015, an adult male was presented at the local animal market in Baghdad. It was trapped in a desert area (*c*. 20 km) northwest of Al-Nekheab in Al-Anbar Province (Fig. 2). Sand Cats are vulnerable to indiscriminate trapping, but

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Fig. 1. Juvenile female Arabian Sand Cat *Felis margarita harrisoni* trapped near Al-Shabakah (Shbecha) in Al-Najaf Province and presented at the local animal market in Baghdad.
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Fig. 2. Adult male Arabian Sand Cat *Felis margarita harrisoni* in captivity trapped Al-Nekheab in Al-Anbar Province.
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unlikely to be directly targeted. They are sometimes caught for the international pet trade which is an ongoing activity, but the scale is not known (Mallon & Budd 2011). Illegal trapping with weak implementation of the hunting laws has been highlighted as a major threat on wildlife in Iraq (Al-Sheikhly et al. 2015). The newly recorded Sand cats were accidentally trapped by local truffle collectors who become active during rainy seasons (January –April) in southern and western deserts of Iraq. Interviews indicated that Sand cats were coincidently observed by truffle collectors at night and early morning. Sand cats accidentally flashed by the collectors' spotting torchlight, chased until they get tired and rest among desert vegetation, and then are caught by hand. After a few days, Sand cats are brought to Baghdad by the truffle collectors and presented in the local animal markets in order to be sold as pets. The trapped cats were stressed, suffering from careless handling, and exhausted due to long distance transportation. The young female seemed to be born in the wild which suggests that Sand cats are breeding in suitable habitats in the southern and western deserts of Iraq (Fig.1).

The ecological requirements of Sand cats in Iraq and around the region are still poorly understood. Due to the rarity of the species, its distribution, status and the impact of threats are difficult to assess. Apart from new spatially and temporally localized records in a few range countries, no easily measurable changes within its distribution area are apparent (Sliwa 2013). Therefore, additional research needs to be performed to document the present continuous occurrence and to assess its status.

Acknowledgments. We are grateful the Iraqi Green Climate Organization (IGCO) for providing information on Sand Cats in Iraq. We would like to thank Hisham Kher Allah for providing additional information on Sand cat sightings in Iraq.

Table 1. Records of the Arabian Sand Cat *Felis margarita harrisoni* in Iraq.

	Number	Site	Coordinates	Date of trapping	Province	Reference
1	Male	West of Al-Najaf city	–	January 2012	Al-Najaf	Mohammad et al. 2013
2	Female	West of Al-Najaf city	–	January 2012	Al-Najaf	Mohammad et al. 2013
3	Male	Al-Jufaira oasis in the desert of Al-Najaf	–	November 2012	Al-Najaf	Mohammad et al. 2013
4	Male (Ad.)	near Al-Shabakah (Shbecha)	30°48'N 43°40'E	February 2014	Al-Najaf	New observation
5	Female (Juv.)					
6	Male (Ad.)	Takhadid (*c.*40km) southwest Nigr'at Al-Salman	30°11'N 44°13'E	March 2014	Al-Muthana	New observation
7	Male (Ad.)	(c. 20) km northeast of Al-Nekheab	32° 6'N 42° 2'E	April 2015	Al-Anbar	New observation

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Six new records of Afrotropical lizard and snake species (Reptilia: Squamata) from the Republic of South Sudan

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Abstract. We report on reptilian specimens collected in southern Sudan (currently the Republic of South Sudan) in 1978 and stored at the Zoologisches Forschungsmuseum Alexander Koenig, Bonn. Six species (one lizard, *Leptosiaphos kilimensis*, and five snakes, *Hapsidophrys lineatus*, *Thrasops jacksoni*, *Toxicodryas pulverulenta*, *Amblyodipsas unicolor*, *Atheris squamigera*) are documented as new records for the fauna of South Sudan and are discussed in a biogeographical context.

Key words. Northeastern Africa, new country records, biogeography.

INTRODUCTION

The Herpetology Section of the Zoologisches Forschungsmuseum Alexander Koenig (ZFMK) in Bonn was founded in 1951 (Böhme 2014), but half a century earlier in several missions between 1897 and 1913, the founder of the museum, Alexander Koenig, had collected already amphibians and reptiles from all over the former Sudan, which is today divided into two countries: the Islamic Republic of Sudan in the north and the Republic of South Sudan. Between 1976 and 1984 Gerhard Nikolaus and Hans Rupp explored the avifauna of Sudan (Sudan and South Sudan) during several trips (Nikolaus 1987) and collected a large number of amphibians and reptiles, as well as birds and small mammals, from these countries that were deposited at the ZFMK. The latest acquisition of Sudanese (Sudan and South Sudan) amphibians and reptiles reached the ZFMK in the 1980's, collected by Hans-Erkmar Back and by Ulrich Joger. In total, specimens representing more than 150 herpetological species from all over the former entire Sudan are housed at ZFMK. As a first step we studied the preserved snake and lizard specimens of these collections and examined 485 lizards belonging to 49 species and 261 snakes belonging to 61 species. In this first note, we recorded and documented one lizard and five snake species from the Republic of South Sudan that were not known from this country before. Other results of our work on this material will follow in further publications.

All specimens cited in the present work were collected by Gerhard Nikolaus and Hans Rupp during their avifaunal surveys in Sudan in 1978. Furthermore, all collecting sites of the six new country records (Yei, Katire, Gilo, Kinyeti and surroundings) are situated in the southern part of South Sudan, i.e. in the historical Equatoria Region (Fig. 1). Yei is situated in Central Equatoria (now Yei River state) near the border with Uganda and the Democratic Republic of the Congo (DRC), on the main road that leads from the South Sudanese capital Juba to Faradje, in the DRC. The Imatong Mountains, with their highest peak Mt. Kinyeti (3180 m a.s.l.) and Katire as the major settlement, are situated in Eastern Equatoria (now Imatong state), also near the Ugandan border. These parts of South Sudan are characterized by woodland, forests, and highland forests (Jackson 1956, Friis & Rasmussen 1981, Nikolaus 1987). The Imatong Mountains, in particular, have an important biogeographical role as a link between the highlands of East Africa and Ethiopia, and also as a shelter of some of the easternmost examples of the Guineo-Congolian rainforests, such as the Lotti and Talanga forests (Friis & Rasmussen 1981).

LIST OF THE NEW COUNTRY RECORDS OF SQUAMATA FOR SOUTH SUDAN

Order Squamata

Family Scincidae

Leptosiaphos kilimensis (Stejneger, 1891)
Proceedings of the United States National Museum 14 (802): 405–406. Type locality: Kilimanjaro, Tanzania, East Africa.

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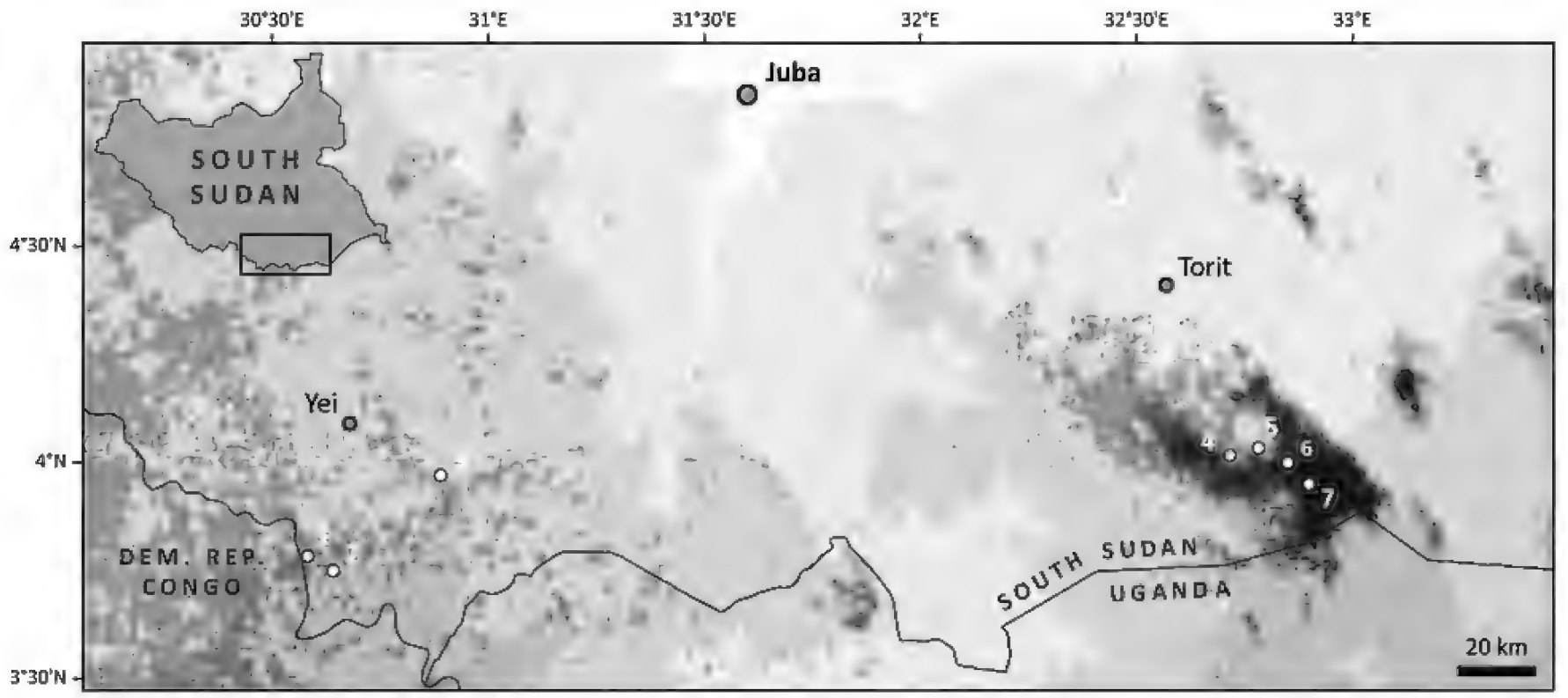

Fig. 1. Map of the Equatoria Region of South Sudan, showing the collection sites of the new records reported in the present study. 1. Kajiko North (03°47'N, 30°35'E, 1000 m); 2. Iwatoka/Watoka (03°45'N, 30°38'E, 1000 m); 3. Mt. Korobe (03°58'N, 30°52'E, 1590 m); 4. Talanga (04°01'N, 32°43'E, 950 m); 5. Katire (04°02'N, 32°47'E, 1000 m); 6. Gilo (04°00'N, 31°51'E, 1900 m); 7. Mt. Kinyeti (03°55'N, 32°55'E, 3180 m).

Fig. 2. *Leptosiaphos kilimensis* (ZFMK 26059) from Mt. Korobe, South Sudan (locality no. 3 on Fig. 1).

Fig. 3. *Hapsidophrys lineata* (ZFMK 2626072) from Kajiko North, South Sudan (locality no. 1 on Fig. 1).

Voucher specimen. South Sudan: south of Yei, Mt. Korobe, collected by G. Nikolaus, 28 July 1978 (ZFMK 26059; Fig. 2).

Remarks. Spawls et al. (2002) listed this leaf-litter skink for Tanzania, Kenya, Uganda and elsewhere south-west to Angola. Identification followed Perret (1982), Broadley & Howell (1991) and Spawls et al. (2002). Our specimen of *Leptosiaphos kilimensis* shows five toes and a lower eyelid with a central window in contrast to *Leptosiaphos blochmanni*, *L. meleagris* and *L. hackarsi* with three or four digits and the lower eyelid scaly, and *L. graueri* with the lower eyelid scaly, too. The frontoparietals are not fused with the interparietal as it is normally the case in *L. rhomboidalis*. Specimen ZFMK 26059 (Fig. 2) shows five digits on forefoot in contrast to *L. aloysiisabaudiae* with only four digits on forefoot.

Family Colubridae

Hapsidophrys lineata Fischer, 1856

Abhandlungen des Naturwissenschaftlichen Vereins Hamburg (3) 4: 79–116. Type locality: Elmina, Ghana.

Voucher specimen. South Sudan: south of Yei, Kajiko-North, collected by G. Nikolaus, 20 July 1978 (ZFMK 26072; Fig. 3).

Remarks. Spawls et al. (2002) listed this widely distributed forest species for Uganda, Kenya, DR Congo, elsewhere south-westwards to northern Angola and westwards to Guinea. Schmidt (1923), Pitman (1974) and Broadley & Howell (1991) reported this species also for Tanzania. In Uganda, this species is more widely distributed in the southwest of the country; otherwise there are only a few scattered records near Entebbe and in the Mabira and Budongo forests (Spawls et al. 2002). Our voucher specimen from south of Yei (Fig. 3) represents, therefore, a considerable range extension to the north and not simply a border-crossing continuation of the Ugandan distribution range.

Fig. 4. *Thrasops jacksonii* (ZFMK 26008) from between Katire and Talanga, South Sudan (localities nos. 4 and 5 on Fig. 1).

Fig. 5. *Toxicodryas pulverulenta* (ZFMK 26030) from Talanga Forest, South Sudan (loclocality no. 4 on Fig. 1).

Thrasops jacksoni Günther, 1895
Annals and Magazine of Natural History (London) (6) 15: 523–529.
Type locality. Kavirondo, Kenya.
Voucher specimens. South Sudan: between Katire and Talanga, collected by H. Rupp, 20–25 July 1978 (ZFMK 26008; Fig. 4); South Sudan: Gilo, collected by G. Nikolaus, 29 October 1978 (ZFMK 29573).
Remarks. Broadley & Wallach (2002) listed "southern Sudan" as part of the distribution range of this species and marked this also in a grid map, however, without providing locality data or a voucher specimen. Upon request, we were informed by D.G. Broadley (in litt.) that he had based this statement on an unpublished report by Friis & Rasmussen (1981), who collected one specimen of *Thrasops jacksoni* in the Imatong Mountains, South Sudan, between 29 October and 22 December 1980, also without any further data. Their voucher specimen is deposited in the Zoological Museum, University of Copenhagen under ZMUC R 601199 (the "60" being a code number for colubrid snakes). Our two specimens reported here are therefore, together with the ZMC specimen, the first documented records for the South Sudan. Spawls et al. (2002) listed this species only for Uganda, Rwanda, Tanzania, Kenya, and the Democratic Republic of Congo. According to these authors, this species also seems to be absent from the northern half of Uganda, so there is a relatively large gap between the Ugandan records and our new records from the Imatong area in South Sudan.

Toxicodryas pulverulenta (Fischer, 1856)
Abhandlungen des Naturwissenschaftlichen Vereins Hamburg 3 (4): 79–116.
Type locality. Liberia; restricted or "corrected" to Sao Tomé by Hughes & Barry (1969).
Voucher specimen. South Sudan: Talanga-Forest (Kinyeti), collected by H. Rupp, July 1978 (ZFMK 26030).
Remarks. Spawls et al. (2002) listed this forest and woodland species (as *Boiga pulverulenta*) for Kenya, Uganda and the DR Congo, elsewhere westwards to Guinea and south-westwards to northern Angola. This confirms data from Pitman (1974) and Chippaux (2001). The Ugandan localities listed by Spawls et al. (2002, see also the map by these authors) leave the northern third of the country without records. Thus, again in this case, the geographic distance to the new South Sudanese locality of the specimen ZFMK 26030 (Fig. 5) is remarkable.

Fig. 6. *Amblyodipsas unicolor* (ZFMK 26088) from Gilo, South Sudan (locality no. 6 on Fig. 1).

Fig. 7. *Atheris squamigera* (ZFMK 26000) from Iwatoka/Watoka, South Sudan (locality no. 2 on Fig. 1).

Family Atractaspididae

***Amblyodipsas unicolor* (Reinhardt, 1843)**

Danske Videnskabernes Selskabs Afhandlinger 10: 233–279.

Type locality. Guinea Coast = Ghana.

Voucher specimen. South Sudan: Imatong Mountains, Gilo, collected by G. Nikolaus, 20 June 1978 (ZFMK 26088).

Remarks. The distribution of this species is centred on West Africa (Spawls et al. 2002, Trape & Mané 2006) with a few records in East Africa (Tanzania, Kenya, Uganda) (Schmidt 1923, Pitman 1974). Its presence in the forested area of the Imatong Mountains in South Sudan, documented by ZFMK 26088 (Fig. 6), is therefore a remarkable range extension. The three Ugandan localities (Spawls et al. 2002: Kampala, Kinja, Masindi) are not close to the Ugandan-South Sudanese border.

Family Viperidae

Atheris squamigera (Hallowell, 1854)

Proceedings of the Academy of Natural Sciences Philadelphia 3(1): 193–194.

Type locality. "near the river Gabon, Guinea". According to Loveridge (1957), the type locality is in the 'French Congo', a French colony which at one time comprised the present-day area of the Republic of the Congo, Gabon, and the Central African Republic.

Voucher specimen. South Sudan: Iwatoka (= Watoka, near Yei), collected by H. Rupp, September 1978 (ZFMK 26000).

Remarks. In East Africa, this forest-dwelling species has been documented for Uganda, Kenya and Tanzania; elsewhere westwards to Nigeria, Ghana and Ivory Coast and south-westwards to northern Angola (Spawls & Branch 1995, David & Ineich 1999, Spawls et al. 2002). The Ugandan localities, mostly isolated from each other, are listed in Spawls et al. (2002), but none of them is close to the South Sudanese border. These data again highlight the importance of our new record (Fig. 7) from near Yei.

DISCUSSION

Scale counts of all specimens mentioned above are within the known range characteristic of each species; hence they are not discussed here. Similarly, the single specimens on whom our new country records are based would not be relevant for any scale count comparisons.

All new records are forest species and belong in all cases to known, widely distributed species. Imatong Mountains also harbour endemics, such as the chameleon *Trioceros kinetensis* (Schmidt, 1943) (Böhme & Klaver 1980), whose relatives are distributed in East Africa, including the Eastern Arc Mountains. Only two species from our new records occur only in East Africa, viz. *Leptosiaphos kilimensis* and *Thrasops jacksoni*. The former has a patchy distribution in Uganda, Kenya and Tanzania (Spawls et al. 2002), the latter reaches also the eastern forests of the Congo Basin in DRC but is replaced further west by other, closely related species (Fischer & Hinkel 1992, Spawls et al. 2002). The other four species, viz. *Hapsidophrys lineata*, *Amblyodipsas unicolor*, *Toxicodryas pulverulenta* and *Atheris squamigera*, have a large distribution through the Congo Basin westwards to Cameroon, Ghana or even Guinea. Biogeographically, they may be regarded as Guineo-Congolian faunal elements and might indicate that the South Sudanese relic rainforests, including the Imatong Mountains, can be considered as northernmost outliers of the Guineo-Congolian realm, with some biogeographic connection to the Eastern Arc Mountains. There is also one lizard showing a similar biogeographic distribution, i.e. a Guineo-Congolian pattern,

viz. the forest-dwelling lacertid *Adolfus africanus* (Boulenger, 1906), which has been already recorded from the Imatong Mountains (Köhler et al. 2003).

These six reptile species newly recorded for the fauna of South Sudan have in common a wide separation from the nearest Ugandan records, which are not located just across the Uganda border but considerably further south. This underscores the importance of the South Sudanese relic forest patches, including the Imatong Mountains, as they have biogeographic relationships with both the East African Arc and the Guineo-Congolian forests. Certainly, the Equatoria Region of South Sudan is greatly understudied in terms of its biodiversity, and the number of squamates newly recorded in this study points out the potential for another hotspot of herpetological diversity in this country. We hope that the Republic of South Sudan will soon return to political conditions that make further basic research and nature conservation possible.

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Review of the *Eumerus barbarus* species group (Diptera: Syrphidae) from the western Mediterranean Basin

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Abstract. The species of the *Eumerus barbarus* group from the western parts of the Mediterranean Basin are revised. Two species new to science are described, i.e. *Eumerus gibbosus* **sp. n.** (from Portugal and Spain) and *Eumerus schmideggeri* **sp. n.** (from Algeria, Morocco and Tunisia). The other two species included in this group are *Eumerus barbarus* (Coquebert, 1804) and *Eumerus sulcitibius* Rondani, 1868. A neotype is designated for *E. barbarus* and we also designated a lectotype for *Eumerus iris* Loew, 1848. All species are figured, their synonyms are reviewed and an identification key is presented. *Eumerus truncatus* Rondani, 1868 is withdrawn from synonymy with *E. barbarus* and considered a *bona species*; additionally, this species is recorded from Morocco, Portugal, Spain and Tunisia for the first time. A short discussion on the value of the Mediterranean Basin as biodiversity hotspot for hoverflies is given.

Key words. *Eumerus barbarus* group, new species, description, Mediterranean Basin, hotspot, threat.

INTRODUCTION

Eumerus Meigen, 1822 is a well-defined genus restricted to the Old World, except for some Australasian species. It is one of the largest syrphid genera in the world, with over 250 described species (Pape & Thompson 2013). Some species have been introduced in other regions, notably the New World, with bulbs transported by man for commerce (Gibbson 1917; Sasscer 1919; Smit 1928; Neboiss 1957; Marinoni & Morales 2007; Speight et al. 2013). The larvae are known to feed in or on decaying roots, bulbs and fleshy matter of Liliaceae, Amerillaceae, Orobanchaceae and even in New World cacti, and some species are regarded to be pests of diverse ornamental bulbs and ginger (Collin 1920; Smit 1928; Martin 1934; Sathiamma 1979; Pérez-Banón & Marcos-García 1998; Ricarte et al. 2008).

The present study deals with the species belonging to the *E. barbarus* group as defined by Chroni et al. (2017). Chroni et al. (2017) used the name *E. sulcitibius* group for *E.* aff. *barbarus* and *E. sulcitibius* Rondani, 1868. As the name *E. barbarus* (Coquebert, 1804) is senior to *E. sulcitibius*, the correct name is *E. barabarus* species group. This grouping does not reflect a phylogenetic ranking as the taxonomy and phylogenetics of *Eumerus* still require revision (Doczkal 1996; Doczkal & Pape 2009). As the females of this group are difficult to distinguish from each other and even from other *Eumerus* species, the diagnosis for each species reviewed here is therefore only based on males. The characters used in the key to the females are often subtile and a certain identification is not always possible.

The aim of the present work is to review the species of the *Eumerus barbarus* group from the western parts of the Mediterranean Basin and to describe two species new to science, namely *Eumerus gibbosus* sp. n. (from Portugal and Spain) and *Eumerus schmideggeri* sp. n. (from Algeria, Morocco and Tunisia). Moreover, we figure all the species of the *barbarus* group, designate a neotype for *Eumerus barbarus*, a lectotype for *Eumerus iris* Loew, 1848 and provide an identification key. *Eumerus truncatus* Rondani, 1868 is withdrawn from synonymy with *Eumerus barbarus* and considered a *bona species*.

MATERIAL AND METHODS

The countries considered here as part of the western Mediterranean Basin are Algeria, France, Italy, Morocco, Portugal, Spain and Tunisia.

Male genitalia and abdomen were dissected by means of entomological pins and forceps from dry or softened specimens. Genitalia and abdomen were boiled in a 10% KOH solution. Once cleared sufficiently, genitalia and sterna IV were placed in glycerine and photographed in a Nikon SMZ dissecting microscope with a Leica MC 190

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HD mounted camera. The photographs of the male sternum IV were touched up in Adobe Photoshop©, and the photographs of the genitalia were used as a template to draw them in Adobe Illustrator©. The photos of the external structures were taken with a Canon EOS 6D mounted on a 2.5 times phototube attached to a Wild M10 stereomicroscope. The photos of the habitus and body parts were processed with Zerene Stacker version 1.04 and further edited with GNU Image Manipulation Program 2.8.16. SEM images (Fig. 9) are made with a VEGA 3xm (Tescan).

Morphological terminology follows Thompson (1999), and terms related to the male genitalia follow Doczkal (1996). The measurements were made with the use of a micrometre. The body is measured from the posterior end of the antennae to the posterior tip of the abdomen; width of head is measured at its maximum width in dorsal, respectively frontal view; the width of the face is measured just below the antennae; width of ocellar triangle is measured over the posterior ocelli in dorsal view; the length of the ocellar triangle is measured from the anterior end of the anterior ocellus to the midline posterior of the posterior ocelli; the length of the frontal triangle is measured from the anterior corner of the eye contiguity to the posterior corner of the lunule in dorsal view; the length of the vertical triangle is measured from the posterior corner of the eye contiguity to the anterior ocellus in dorsal view, the eye contiguity itself is the length in between the previous two measurements; the width of the vertex in dorsal view is measured posteriorly between the posterior corner of the eyes (a), over the posterior ocelli (b) and over the anterior ocellus (c); the length of the basoflagellomere is measured in lateral view from the most anterior part of the pedicel to the apex of basoflagellomere and the width is measured at its widest point, perpendicular to the midline; the length of the metafemur as well as the tarsomeres of the metatarsus is measured in posterior view from the base to the apex along the midline and the width is measured at its widest point, perpendicular to the midline.

In the description of type labels, the contents of each label is enclosed within double quotation (“ ”), italics denote handwriting, and the individual lines of data are separated by a forward slash (/).

DEPOSITORIES

AET private collection of Andre van Eck, Tilburg, The Netherlands
CSCA California State Collection of Arthropods, Department of Food & Agriculture, Sacramento, California, USA
CEUA Colección Entomológica de la Universidad de Alicante, Centro Iberoamericano de la Biodiversidad, Alicante, Spain
JSA private collection of Jeroen van Steenis, Amersfoort, The Netherlands
LACM Los Angeles County Museum, Los Angeles, California, USA
MNCN Museo Nacional de Ciencias Naturales, Madrid, Spain
MNHN Laboratoire d’Entomologie, Muséum national d’Histoire naturelle, Paris, France
MZUF Museo Zoologico “La Specola”, Firenze, Italy
MZW private collection of Menno van Zuijen, Wageningen, The Netherlands
NBC Natural Biodiversity Centre, Leiden, The Netherlands
NHM The Natural History Museum, London, United Kingdom
ZMHB Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany

RESULTS

The western Mediterranean species of the *Eumerus barbarus* group

The *barbarus* group contains four *Eumerus* species in the western parts of the Mediterranean Basin: *E. barbarus*, *E. sulcitibius*, *Eumerus gibbosus* sp. n., and *Eumerus schmideggeri* sp. n. Until recently, *Eumerus truncatus* Rondani, 1868 was regarded as a synonym of *E. barbarus*. Grković et al. (2015) treated *E. truncatus* as *bona species* (from several Greek Isles), but without giving any reference to its recognition or former synonymy. We examined specimens of this species, including the type material, and concluded that *E. truncatus* is not a species of the *Eumerus barbarus* group as defined here, which can be seen from the redescription provided below.

Diagnosis of the *Eumerus barbarus* species group

As recognised here, the species of the *Eumerus barbarus* group share the following characteristics: Face with dense white pollinosity and white to light-yellow pile (Figs 4A, 4B, 4D–4I)), with mouth edge narrowly shiny black. Eyes white pilose, about 1/4–1/2 times as long as facial pile; male with rather long eye contiguity, 7–9 ommatidia long (Figs 3A, 3D, 3F, 3H). Vertex broad, ocellar triangle isosceles, located anteriorly on vertex, with widely separated posterior ocelli; anterior part and two small maculae along eye margin just posterior of posterior ocelli white pollinose (Figs 3A, 3B, 3D–I). Basoflagellomere oval with rounded apico-dorsal corner (Fig. 6). Thorax with two medial narrow white pollinose vittae on nearly entire length (Figs 1A, 1B, 1D–1I); on supra-alar region with a row of

8–12 short black setulae; shiny colour with copper to golden purple sheen. Notopleural suture absent. Abdomen black with different shiny colours (black, copper to gold) and with white pollinose lunulate maculae on terga II–IV and short black and white pile.

Males of the *barbarus* group can be distinguished with the following characteristics: Metatrochanter with low tubercle to triangular process ventro-medially (Fig. 7). Metafemur strongly incrassate (thickened) with long pile ventrally (Fig. 7), apico-posteriorly with pilose lamina of different size, with long row of black spinae along postero-ventral margin or with additionally several larger spinae ventro-medially (Figs 7, 8). Metatibia ventro-basally with spinose carina along medial surface and a well-developed lamina posteriorly (Fig. 9B); in *E. gibbosus* **sp. nov**. carina weakly developed and lamina only present at extreme apex and weakly developed. Genitalia with elongate surstylus with hook shaped apex (Fig. 11).

Eumerus barbarus (Coquebert, 1804)

Figs 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 6A, 6B, 7A, 8A, 9A, 10A & 11A

Syrphus barbarus Coquebert, 1804: 117. Type locality: Barbaria Mus. Dom. Desfontaines [Neotype ♂, ZMHB, here designated].
Eumerus australis Meigen, 1838: 110. Type locality: Spain, Andalusia [Holotype ♀, MNHN].
Eumerus iris Loew, 1848: 118. Type locality: Italy, Sicily, Syracuse [Lectotype ♂, ZMHB, here designated].
Eumerus truquii Rondani, 1857: 95. Type locality: Italy, Piemont [Holotype ♀, MZUF].

Diagnosis. Metafemur (Figs 7A, 8A, 9A) strongly incrassate, with broad flat non pilose area ventrally with postero-ventral row of spinae covering nearly the entire length of the metafemur; metafemur apico-posteriorly with low lamina covered with dense white pile; metatibia (Figs 7A, 8A) ventro-basally along medial surface with broad carina, posteriorly with very broad lamina; sternum IV (Fig. 10A) squarish, in lateral view with characteristic postero-medial rounded extensions, in ventral view with laterally projecting rounded postero-lateral corner and deep and wide incision medially. Genitalia (Fig. 11A): surstylus with very narrow medial lobe and apical lobe elongate, gently curved margins with sharp, weakly bent apex; hypandrium with rather broad apical part and with weakly rounded and smooth ventral margin.

Redescription. MALE (Figs 1A, 2A). Body length: 6.8–8.7 mm, wing length: 4.7–6.3 mm. **Head** (Figs 3A, 4A). Face nearly parallel sided. Frons light-grey pollinose, with scattered light yellow pile. Ratio width of head : width of face 2.9–3.1 : 1. Eye contiguity relatively short, ratio frons : eye contiguity : vertical triangle is as 1.4–1.7 : 1.2–1.4 : 1. Vertical triangle grey-yellow pollinose, narrow grey-yellow pollinose along eye margin and two short oval maculae posterior of ocelli, pile golden-yellow, on ocellar triangle ranging from yellow with some black pile intermixed to entirely black pilose. Occiput predominantly grey pollinose, entirely white pilose. Ocelli isosceles with broad posterior base, length : width 1.3–1.4 : 1; posterior ocelli relatively far from eye margin, ratio width of frons : width of ocellar triangle 1.3–1.5 : 1; ratio a:b:c as 1.4–1.6 : 1.2–1.4 : 1; width of head : width of vertex is as 3.7–4.4 : 1. Antennae black to orange-yellow, scape black, pedicel from orange to black, basoflagellomere from entirely orange to yellow with apical half brown to dark-brown. Scape and pedicel with long yellow to black setae and light pile. Basoflagellomere (Fig. 6A) short rectangular, ratio length : width as 1.2–1.3 : 1 with anterior margin skewed ventrally. Arista with broad base, total length 2–3 times longer than basoflagellomere, basal 1/5 yellow to entirely black.

Thorax. Black bronze shiny, pollinose along lateral margin and posterior and anterior of notopleura, two mediolateral pollinose vittae reaching to posterior 2/3–3/4 of scutum, these pollinose vittae with broad triangular anterior part. Pile light yellow. Pleurae bronze black, pilose on proepimeron, postero-dorsal margin of anterior anepisternum, entire posterior anepisternum, anterior half of anepimeron and a dorsal and ventral pile patch on katepisternum. Grey pollinose on pilose parts, others bronze black sub shiny. Metasternum pilose. Scutellum rectangular with narrow marginal rim, shiny black with bronze sheen, golden yellow pilose. **Legs**. Black and brown-yellow to orange coloured. Pro- and mesotarsus orange-yellow, connecting parts of tarsomeres black; pro- and mesotibia basal 1/2–2/3 orange-yellow and with apical black ring sometimes with brow-yellow anterior part; pro- and meso femur apical 1/10 brown-yellow. Pile all yellow with black spinae on ventral side of mesotarsus. Metaleg with coxa black and long white pile; trochanter (Fig. 7A) brown-yellow to black, short scattered mixed yellow and black pile, apicoventrally with short rounded tubercle; femur (Figs 7A, 8A, 9A) black, strongly enlarged, ratio length : width is 2.4–2.7 : 1, with broad flat non pilose area ventrally with antero-ventral row of 5–8 black spinae apically and postero-ventral row of 14–22 black spinae covering nearly the entire length of the metafemur; apico-posteriorly with densely white pilose low lamina; pile light-yellow, nearly evenly long on dorsal surface and short on ventral surface, except long on apicoventral part. Metatibia (Figs 7A, 8A) orange-yellow on basal 1/2 and apical 1/10; only slightly curved, ventro-basally along medial surface with broad carina, posteriorly with very broad lamina; tarsus orange to dark-brown. **Wing**. Entirely microtrichose to partly bare medially on alula and basally on cell bm. **Abdomen**. Shiny bronze black, white pilose, antero-medial

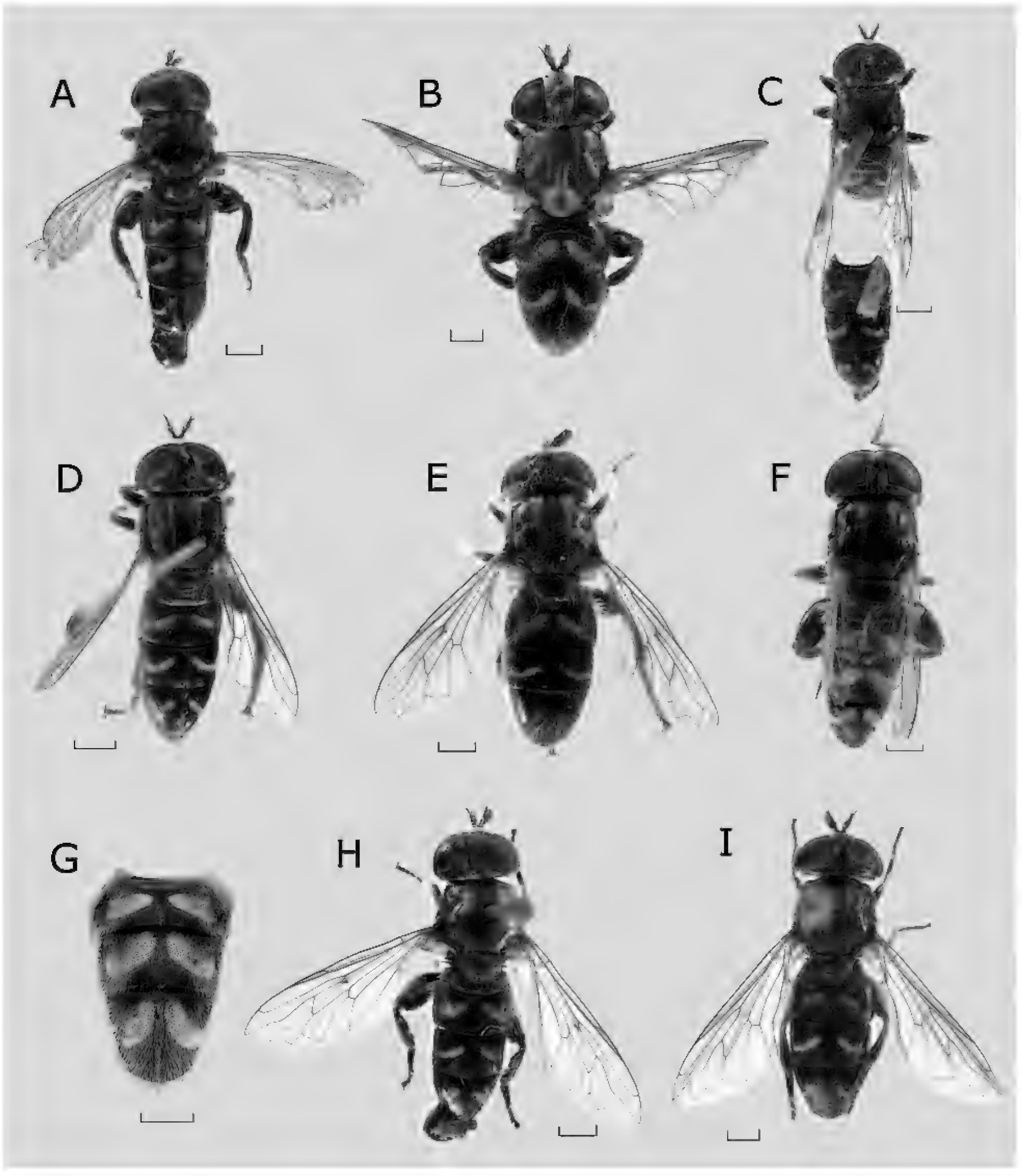

Fig. 1. Adult, dorsal view. **A.** *Eumerus barbarus* (Neotype, ♂). **B.** *Eumerus barbarus* (W. Batna, Algeria, ♀). **C.** *Eumerus truncatus* (Holotype, ♂). **D.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, Paratype, ♂). **E.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, ♀). **F.** *Eumerus schmideggeri* **sp. n.** (Gafsa, Tunisia, Paratype, ♂). **G.** *Eumerus schmideggeri* **sp. n.** (Sidi R'bat, Morocco, Paratype, ♀). **H.** *Eumerus sulcitibius* (Albacete, Spain, ♂). **I.** *Eumerus sulcitibius* (Albacete, Spain, ♀). Scale = 1 mm.

part of terga II–IV with triangular area black pilose; terga II–IV with light-grey pollinose and slightly oblique maculae, medially slightly wider; sternum IV squarish, in lateral view with characteristic postero-medial rounded extensions, in ventral view with laterally projecting rounded postero-lateral corner and deep and wide incision me-

dially; sternum VI predominantly light yellow to entirely black pilose; sternum VII from entirely black to predominantly light-yellow pilose. **Genitalia** (Fig. 11A). Surstylus with squarish basal part with scattered setae ventromedially; medial part narrowly elongate with small patch of setulae at border with apical part of surstylus; apical lobe elongate and gently curved with sharp, weakly bent apex; hypandrium with rather broad apical part and with weakly rounded and smooth ventral margin; hamus elongate to club-shaped with broad apex.

FEMALE (Figs 1B, 2B). Body length: 7.3–10.1 mm, wing length: 5.3–7.1 mm. Similar to male except for the usual sexual dimorphism. **Head** (Figs 3B, 4B). Ratio width of head : width of face 2.6–2.9 : 1. Ocelli isosceles with broad posterior base, length : width 1.2–1.4 : 1; ratio width of frons : width of ocellar triangle 1.8–2.0 : 1; width of head : width of vertex is as 3.0–3.3 : 1. Basoflagellomere (Fig. 6B) large round, orange to light-brown coloured, ratio length : width as 0.93–1.1 : 1. **Legs**. Metafemur black, strongly incrassate, ratio length : width is 2.7–2.9 : 1.

Type material examined. Neotype ♂ *Syrphus barbarus*: **Tunisia**: "N-Tunesien 27.6.1994 / Ghar el Mehl Strand / 35 km SÖ Bizerte / leg. Hauser , Tu-Gha", "*Eumerus barbarus* / (Coquebert, 1804) ♂ / det. M. Hauser 1996", "Neotype ♂ / *Syrphus barbarus* / Coquebert, 1804 / des J. van Steenis, 2016" [red label] (ZMHB).

Holotype ♀ *Eumerus australis*: **Spain**: "—-" [round silver label], "Hispania / *Eumerus* / *australis* / M." (MNHN).

Lectotype ♂ *Eumerus iris*: **Italy**: "Sicilia / 1/5 Zeller", "coll / H. Loew", "Typus"[red label], "Zool. Mus. / Berlin", "Lectotype ♂ / *Eumerus iris* / Loew, 1848 / design. J. van Steenis, 2016" [red label], (ZMHB). This specimen is here designated as lectotype to fix and ensure the universal and consistent interpretation of the name. Paralectotypes: 1 ♂, 2 ♀♀ *Eumerus iris*, with same data as the lectotype (ZMHB). These specimens are here designated as paralectotypes.

Holotype ♀ *Eumerus truquii*: **Italy**: " 141", [white oval label with red text], "Museo La Specola / coll. Rondani / HOLOTYPUS" [red label], "*Eumerus barbarus* / det. Vujić 2014", "Holotype ♀ / *Eumerus truquii* / Rondani, 1857 / det J. van Steenis, 2016" [red label] (MZUF).

Additional material examined. **Algeria**: "Algeria, 4.V.1893, A.E. Eaton", "*Eumerus* sp, nr. *barbarus* N.P. Wyatt det", 1 ♂ (NHM); "Algeria, Constantine, 2.VI.1895, B.M.1896-137, A.E. Eaton" 1 ♀ (NHM)"; "Algeria, Hippone, 8.IV.1896", 1 ♂ (NHM); "Richter / Algers", "*Eumerus ruficornis* / det v/d Wulp", "*Eumerus barbarus* / det. v. Helsdingen 1964", 1 ♂ (NBC); "20 km N de Maghnia / Bab Taza / 9 IV 1983 st 14", Algerie / Tlemcen / R. Leys & / P. v.d. Hurk", 1 ♂ (JSA), 1 ♂ (NBC), 1 ♀ (MZW); same labels except "4 km E / st 33 / 24 IV 1983", 1 ♀ (JSA); same labels except "Tlemcen / camp. municipal / 20 IV 1983 st 4.", 1 ♂ (MZW); same labels except "Mansourah / st 22 / 14 IV 1983", 1 ♂ (NBC); "Algerije / W. Tlemcen /Ain Pezza / 11-4-1981 / leg. R. Hensen", 1 ♂ (NBC); "Algerije / W. Batna / Timgad / 17-4-1981 / leg. R. Hensen", 1 ♀ (NBC); "Mascara Algeria / Dr. J. Bequart", "*Eumerus* / *barbarus* / Coq. ♀", 1 ♀ (MNHN); "Palikao / Mascara Algeria / Dr. J. Bequart", "*Eumerus* / *iris* / Lw.", 1 ♂ (MNHN); **France**: "Banyuls s Mer / France / P.O. / 21-iv-1951 v Doesburg", 1 ♂ (NBC); same label except 8-iv, 9-iv and 20-iv, 5 ♂♂, 1 ♀ (NBC); "France (Corse) / Nonad / 10-v-1963 / HJP Lambeck", 3 ♂♂, 1 ♀ (NBC); "France Corse / J.A.W. Lucas", "Vemaco / 600 m / 18-7-1967", 1 ♂ (NBC); "France Pyr. Or. / St. Cyprien / Plage / 3-VII-1956 / exc Zool Museum", 1 ♂ (NBC); "Sardegna / Teuipio P 24-9-1949 / Castellani leg", 1 ♂, 1 ♀ (NBC); **Italy**: "Sicily, above Trapani, 16.IV.1965, 200m, K.M. Guichard, B.M. 1965-273" 1 ♂ (NHM)"; "Sicily, Selinunte, 13.IV.1965, S.L., K.M. Guichard, B.M. 1965-273" 2 ♂♂ (NHM)"; "Italy / Sardinia Lode / R. Mannu / April 1989 / leg M. Hauser:, 1 ♀ (CSCA); "Ragusa / Italia 18-5-1954 / F.F. Tippmann", "*Eumerus australis* / det v Doesburg", 1 ♂; same label as previous, except "*Eumerus barbarus* / det v Doesburg", 8 ♂♂, 1 ♀ (NBC), 1 ♂ (NHM); "Italia / Sicilie / HJP Lambeck", "Adreno / Passo Zingelo / 650 m / 24-v-1966", 6 ♂♂, 1 ♀ (NBC); "Italia / Sicilia", "Mondello / 10-4-1979 / J.A.W. Lucas", 1 ♂ (NBC); same label as previous, except 11-4, 13-4 and 15-4, 8 ♂♂, 2 ♀♀ (NBC): "Italia / Sicilia / J.A.W. Lucas", "Taormina / 23-4-1976", 3 ♂♂ (NBC); "I-Sardinien Tempio 1200m / Mt. Limbara 20.7.96 / leg.: Dr. Ch.L. Neumann", 1 ♀ (CSCA); "I-Sardinien / april 1989 / Florinas, 417m / M. Hauser leg", "*Eumerus barbarus* Coqu. / det Claussen 1994", "*Eumerus barbarus* / (Coquebert, 1804) ♂ / det.: M. Hauser 1996" 1 ♂, (CSCA); **Morocco**: "Marokko / 11 km NW Tallouine / 15.III.97 30°34′N 8°00′W / leg M. Hauser", 1 ♂ (JSA); "Marokko Antiatlas / S Ait-Baha / 12.III.97 30°06′N 9°02′W / leg M. Hauser", 1 ♂ (CSCA); "Marokko Antatlas Amm- / elental 10km NE Tafraoute / 14.III.[19]97 29°48′N 8°53′W / leg M. Hauser", 2 ♂♂ (CSCA); **Portugal**: "Portugal / 24-4-1985", 2 ♀♀ (NBC); **Spain**: "Mallorca I Andraixt, 26.Mar.1977 G.E.Bohart", 2 ♂♂ (LAMC); "Espana / Mallorca / 1-24-vi-1954 / leg Klokke Moll", "*Eumerus australis* / det v Doesburg", 1 ♀ (NBC); "W. Malta / Wardijn Ridge / Rooan Baths / 20-4-1986 / J.A.W. Lucas", 7 ♂♂, 4 ♀♀ (NBC); "Calvia / Caphella / 1-5.V.1979", "Islas Baleares / Mallorca / W.H. & A.F.E. / Gravestein", 1 ♂ (NBC); "Palma", 1 ♂ (MNCN); "Alicante / Dusmet", 1 ♂ (MNCN); "Vacia Madrid / Dusmet", "MNCN / Madrid", 1 ♂ (MNCN); "Spain, Almeria Province / 800 ft. 3 km W Benhadux / 11-IV-1999 ME Irwin / 36°55.1′N 02°28.64′W / hand netted", 1 ♂ (CSCA); "El Pardo / VI-1908 / Arias", "M.N.C.N. / Madrid", "*Eumerus barbarus* / (Coquebert, 1804) / Det.: A. Ricarte, 2005", "MNCN_Ent / 142918", 1 ♂ (MNCN); "España, Ciudad

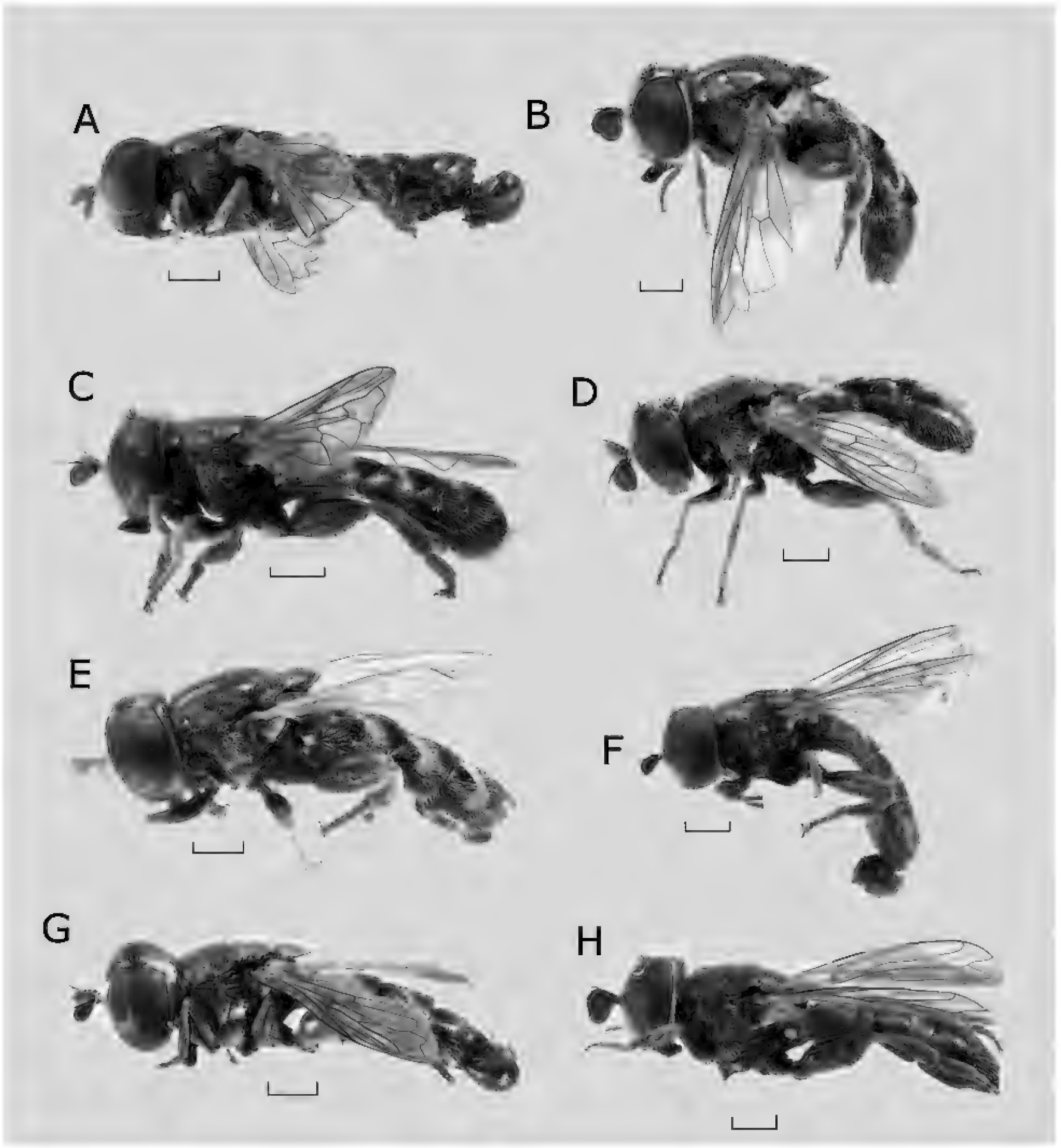

Fig. 2. Adult, lateral view. **A.** *Eumerus barbarus* (Neotype, ♂). **B.** *Eumerus barbarus* (W. Batna, Algeria, ♀). **C.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, Paratype, ♂). **D.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, ♀). **E.** *Eumerus schmideggeri* **sp. n.** (Gafsa, Tunisia, Paratype, ♂). **F.** *Eumerus truncatus* (Holotype, ♂). **G.** *Eumerus sulcitibius* (Albacete, Spain, ♂). **H.** *Eumerus sulcitibius* (Albacete, Spain, ♀). Scale = 1 mm.

Real / P.N. de Cabañeros, maR2 / 1/24-VIII-2004 / leg.: A. Ricarte 5160", "SYRPHIDAE / *Eumerus barbarus* / (Coquebert, 1804) ♀ / Det.: A. Ricarte, 2006 (GBIF)", 1 ♀ (CEUA); same label except "maR1 and 5189", 1 ♂ (CEUA); **Tunisia**: same labels as Neotype, 1 ♂, 1 ♀ (CSCA), 1 ♂ (JSA); "Tunisia S M'Saken / 5 km N Sidi Bou Goubrine / 21.V.1999 ~ 1000 m amsl / 35°36.29′N 10°36.04′E / leg. O. & M. Niehuis", 2 ♂♂, 1 ♀ (CSCA); "W Tunesia / 5 km N El Kef / Tal m. Eryngium / 22.VI.1994 leg Schmid-Egger Tu-Kef", 1 ♀ (CSCA);

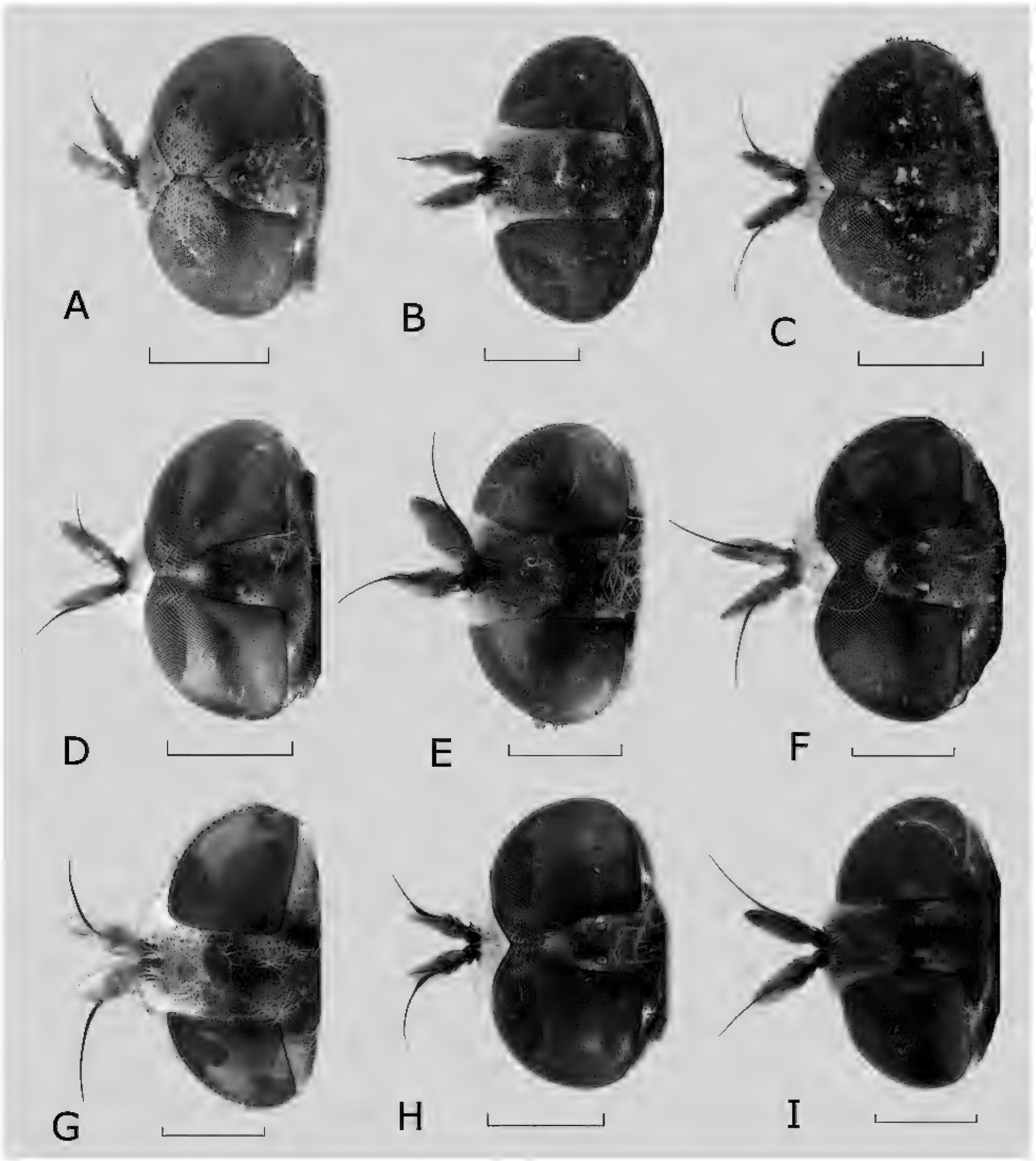

Fig. 3. Head, dorsal view. **A.** *Eumerus barbarus* (Neotype, ♂). **B.** *Eumerus barbarus* (W. Batna, Algeria, ♀). **C.** *Eumerus truncatus* (Holotype, ♂). **D.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, Paratype, ♂). **E.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, Paratype, ♀). **F.** *Eumerus schmideggeri* **sp. n.** (Gafsa, Tunisia, Paratype, ♂). **G.** *Eumerus schmideggeri* **sp. n.** (Sidi R'bat, Morocco, Paratype, ♀). **H.** *Eumerus sulcitibius* (Albacete, Spain, ♂). **I.** *Eumerus sulcitibius* (Albacete, Spain, ♀). Scale = 1 mm.

"Tunesia / Tabarka / Khatairia 15.V.1993", 1 ♂ (CSCA); "5 km E of / Tabarka 50 m / 26-IV-1980 / flower pasture", "Tunesia / E. van Nieukerken, / G. Bryan & / P. Oosterbroek", 1 ♀ (NBC); 3 additional specimens without known country: "Beicos / 1/8", 1 ♀ (MNHN); "Sa....o / Sa..d / Krausse", "*Eumerus* / *barbarus* / Coq. ♀", [handwritten, partly unreadable], 2 ♀♀ (MNHN).

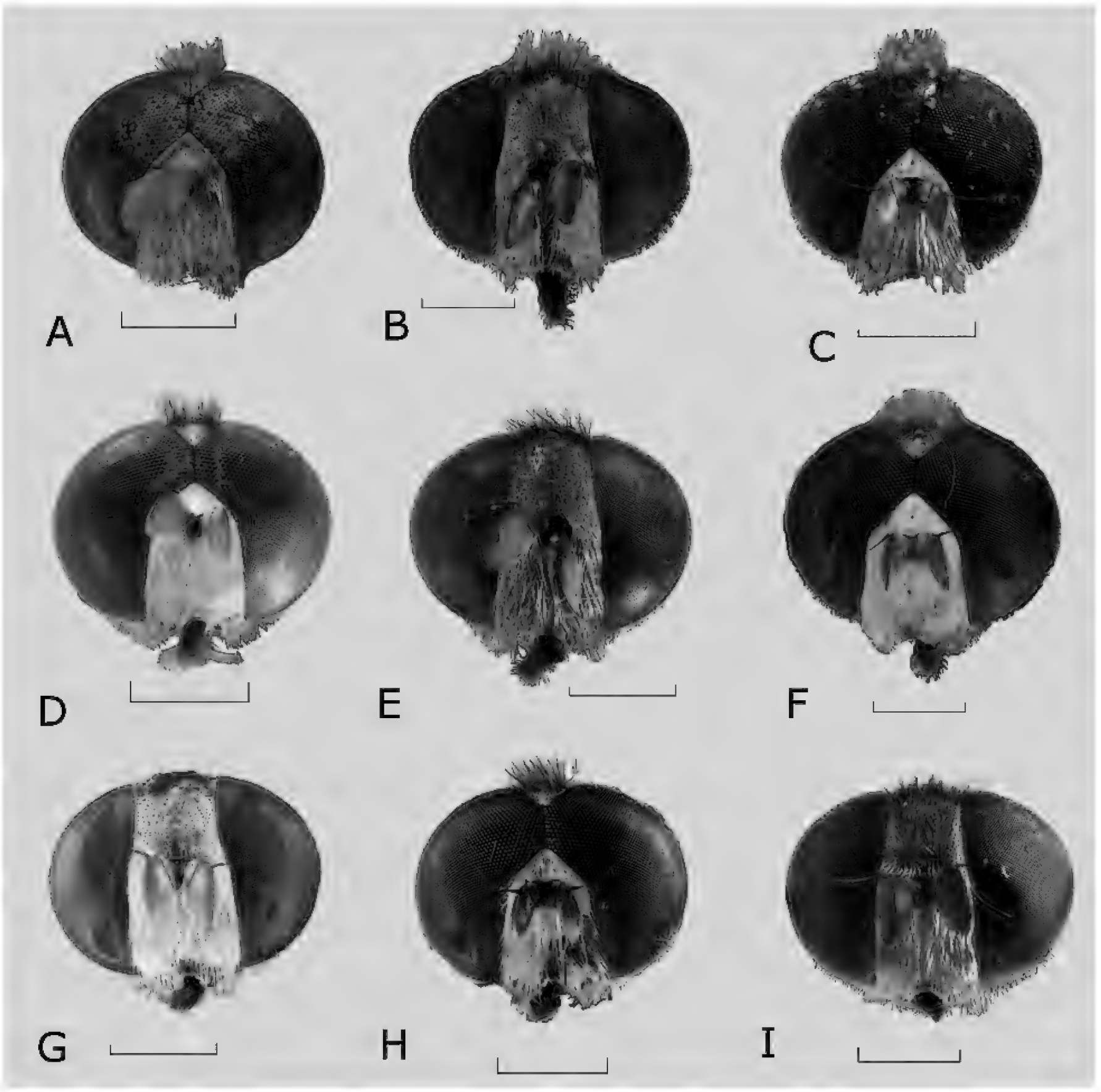

Fig. 4. Head, frontal view. **A.** *Eumerus barbarus* (Neotype, m#). **B.** *Eumerus barbarus* (W. Batna, Algeria, ♀). **C.** *Eumerus truncatus* (Holotype, ♂). **D.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, Paratype, ♂). **E.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, ♀). **F.** *Eumerus schmideggeri* **sp. n.** (Saida, Algeria, Paratype, ♂). **G.** *Eumerus schmideggeri* **sp. n.** (Sidi R'bat, Morocco, Paratype, ♀). **H.** *Eumerus sulcitibius* (Albacete, Spain, ♂). **I.** *Eumerus sulcitibius* (Albacete, Spain, ♀). Scale = 1 mm.

Remarks. This is the most widespread species and, in some places, it seems to be sympatric with the other species. The type of *Syrphus barbarus* Coquebert, 1804 was deposited in the Desfontaines collection "Mus. Dom. Desfontaines" and later placed in the MNHN, but this part of the MNHN collection is presumed to be lost (Zimsen 1964). In the material studied here several specimens of *E. barbarus* have been named either *E. iris* or *E. australis*. In order to fix the usage of the name of *Eumerus barbarus,* we designated a neotype. The locus typicus is given as "Barbaria", and according to Zimsen (1964) the specimens collected by Desfontaines originate from Algeria and Tunisia so we picked a specimen from Tunisia which agreed with the original description.

***Eumerus gibbosus* sp. n.**

Figs 1D, 1E, 2C, 2D, 3D, 3E, 4D, 4E, 6D, 6E, 7B, 8B, 10B & 11B

Diagnosis. Metafemur medio-ventrally with area of light- to dark-brown pile; apico-posterior lamina of metafemur large and densely dark brown pilose (Figs 7B, 8B); metatibia ventro-basally along medial surface with very low carina, posteriorly at extreme base with very low lamina; sternum IV (Fig. 10B) squarish, with normal postero-lateral corners and wide oval incision medially. Genitalia (Fig. 11B): surstylus with wide triangular medial part and elongate and tapering apical part with slightly rounded and sharply bent apex; hypandrium with broad apical part and several projections along ventral margin.

Fig. 5. Habitat of *Eumerus gibbosus* **sp. n.**, Albacete. **A.** Puerto de las Crucetillas. **B.** Cañada del Provencio.

Description. MALE (Figs 1D, 2C). Body length: 6.1–7.5 mm, wing length: 4.0–5.2 mm. **Head** (Figs 3D, 4D). Face nearly parallel sided. Frons light-grey pollinose, with scattered light yellow pile. Ratio width of head : width of face 3.0–3.1 : 1. Eye contiguity relatively short, ratio frons : eye contiguity: vertical triangle is as 1.4–1.5 : 1.1–1.2 : 1. Vertical triangle grey-yellow pollinose, narrow grey-yellow pollinose along eye margin and two short oval maculae posterior of ocelli, pile golden-yellow, on ocellar triangle ranging from yellow with some black pile intermixed to entirely black pilose. Occiput predominantly grey pollinose, entirely white pilose. Ocelli isosceles with broad posterior base, length : width 1.2–1.4 : 1; posterior ocelli relatively close to eye margin, ratio width of frons : width of ocellar triangle 1.2–1.3 : 1; ratio a:b:c as 1.3–1.4 : 1.2–1.3 : 1; width of head : width of vertex is as 4.1–4.5 : 1. Antennae black to orange-yellow, scape black, pedicel from orange to black, basoflagellomere from entirely orange to yellow with apical half brown to dark-brown. Scape and pedicel with long yellow to black setae and light pile. Basoflagellomere (Fig. 6D) short rectangular, ratio length : width as 1.1–1.2 : 1 with anterior margin skewed ventrally. Arista with broad base, total length 2–3 times longer than basoflagellomere, basal 1/5 yellow to entirely black. **Thorax**. Black bronze shiny, pollinose along lateral margin and posterior and anterior of notopleura, two mediolateral pollinose vittae reaching to posterior 2/3–3/4 of scutum, these pollinose vittae with broad triangular anterior part. Pile light yellow. Pleurae bronze black, pilose on proepimeron, postero-dorsal margin of anterior anepisternum, entire posterior anepisternum, anterior half of anepimeron and a dorsal and ventral pile patch on katepisternum. Grey pollinose on pilose parts, others bronze black sub-shiny. Metasternum pilose. Scutellum rectangular with narrow marginal rim, shiny black with bronze sheen, golden yellow pilose. **Legs**. Black and brown-yellow to orange coloured. Pro- and mesotarsus orange-yellow, connecting parts of tarsomeres black; pro- and mesotibia basal 1/2–2/3 orange-yellow and with apical black ring sometimes with brown-yellow anterior part; pro- and mesofemur apical 1/10 brown-yellow. Pile all yellow with black setulae on ventral side of mesotarsus. Metaleg with coxa black and long white pile; trochanter brown-yellow to black, short scattered mixed yellow and black pile, apicoventrally with short rounded tubercle (Fig. 7B); femur (Figs 7B, 8B) black, slightly enlarged, ratio length : width is 3.0–3.5 : 1, with normally curved ventral surface, with ventral surface long white pilose, medio-ventrally with patch of light- to dark brown pile, antero-ventrally with a row of 7–11 black spinae apically and postero-ventrally with a row of 9–14 black spinae along apical 1/2, apico-posterior lamina large and densely dark brown pilose; metatibia orange-yellow on basal 1/2 and apical 1/10; only slightly curved, apically with antero-medial row of black dense spicules and ventro-basally along medial surface with very weak carina, posteriorly at extreme base with very low lamina; tarsus orange to dark-brown. **Wing**. Microtrichose, except bare on very small medial part on alula and extreme base of cell bm. **Abdomen**. Shiny bronze black, white pilose, antero-medial part of terga II–IV with triangular area black pilose; terga II–IV with light-grey pollinose and slightly oblique maculae, medially slightly wider; sternum IV (Fig. 10B) squarish, with normal postero-lateral corners and wide oval incision medially; sternum VI predominantly light yellow to entirely black pilose; sternum VII from mixed black and light-yellow to predominantly light-yellow pilose. **Genitalia** (Fig. 11B). Surstylus with large squarish basal part with very scattered setae ventro-medially; medial part widely triangular with scattered setulae; apical part elongate with slightly rounded and sharply bent apex. Hypandrium with broad apical part with two squarish projections along ventral margin and with dense patch of small setulae ventro-apically; hamus short and with large round apex.

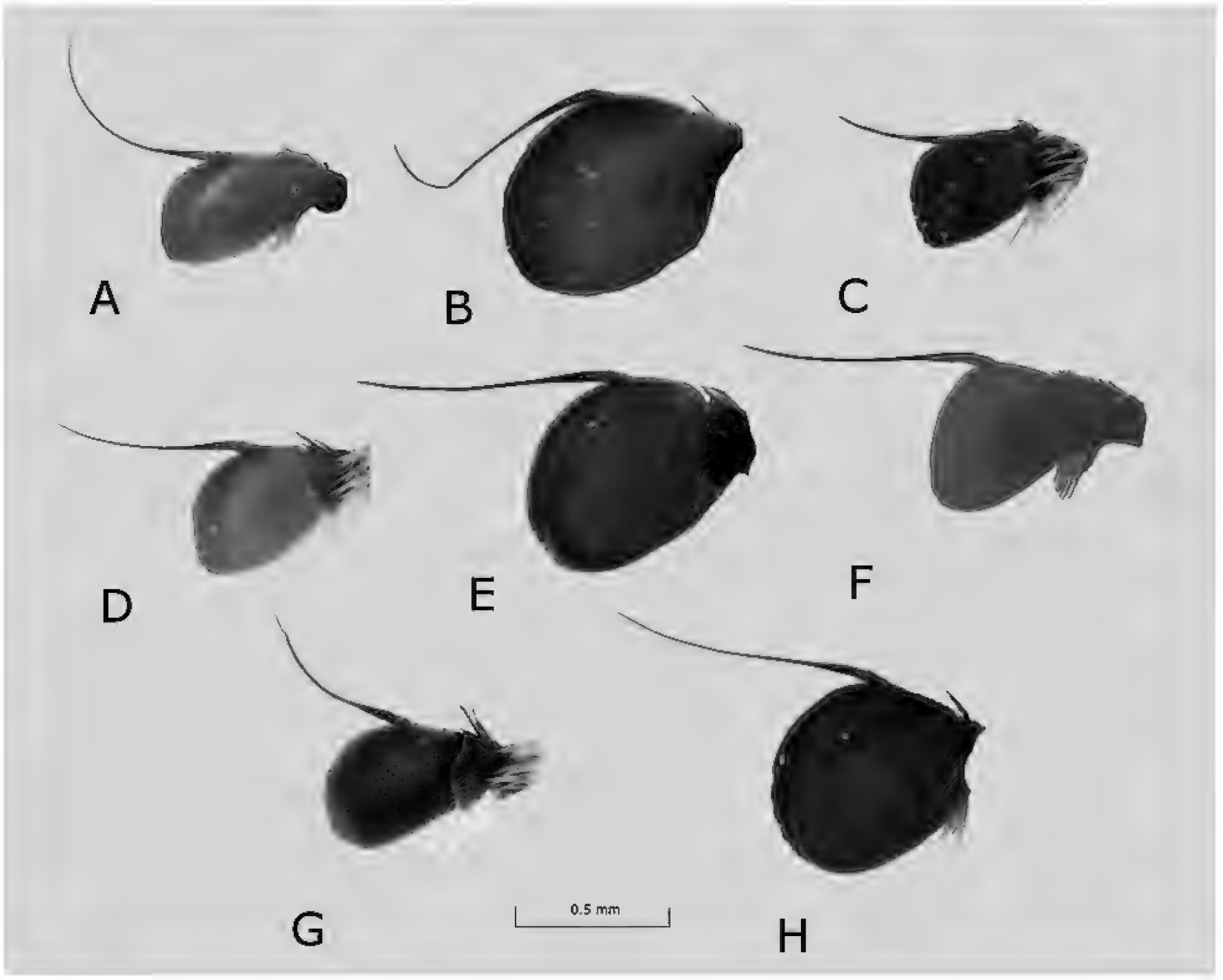

Fig. 6. Antennae, lateral view. **A.** *Eumerus barbarus* (Neotype, ♂). **B.** *Eumerus barbarus* (Tlemcen, Algeria, ♀). **C.** *Eumerus truncatus* (Holotype, ♂). **D.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, Paratype, m#). **E.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, ♀). **F.** *Eumerus schmideggeri* **sp. n.** (Gafsa, Tunisia, Paratype, m#). **G.** *Eumerus sulcitibius* (Albacete, Spain, ♂). **H.** *Eumerus sulcitibius* (Albacete, Spain, ♀). Scale = 0.5 mm.

FEMALE (Figs 1E, 2D). Body length: 7.8–8.2 mm, wing length: 5.8–6.1 mm. Similar to male except for the usual sexual dimorphism. **Head** (Figs 3E, 4E). Ratio width of head : width of face 2.7–2.8 : 1. Ocelli isosceles with broad posterior base, length : width 1.3–1.5 : 1; ratio width of frons : width of ocellar triangle 1.5–1.7 : 1; width of head : width of vertex is as 3.8–4.0 : 1. Basoflagellomere (Fig. 6E) round to slightly oval, dark orange-brown coloured with darker antero-dorsal margin, ratio length : width as 0.97–1.1 : 1. **Legs**. Metafemur black, slightly incrassate, ratio length : width is 2.6–2.9 : 1. **Abdomen**. Tergum IV without pollinose maculae.

Etymology. The characteristics which separate this species from closely related species are the two humps on the ventral margin of the hypandrium; "gibbosus", the Latin word for humped.

Biology. The specimens from Spain were collected in a low mountainous area with open Pine (*Pinus halepensis* Miller and *P. nigra* Arnold) dominated forest with undergrowth of Mediterranean maquis with diverse yellow and white flowering Apiacaea (Fig. 5).

Type material. HOLOTYPE ♂: **Spain**: "Spain Albaceta / [leg] J. van Steenis & M.P. van Zuijen", "Sierra de Alcaraz, 1400 m [a.s.l.] / Puerto de las Crucetillas / [road] C 415 km 190, open pine forest / 38°31′N 2°26′W / on *Thapsia villosa* / 21-VI-2003" (NBC). **Paratypes**: **Spain**: with same data as Holotype, 1 ♂, 1 ♀ (CSCA), 1 ♂, 1 ♀ (JSA); with same data except "Sierra de Alcaraz, 1000 m [a.s.l.] / river valley, meadow marsh / Cañada del Provencio / 38°31′N 2°20′W / on *Thapsia villosa* / 22-VI-2003", 2 ♂♂ (JSA); "Spain (E) Albacete, Riopar / Puerto

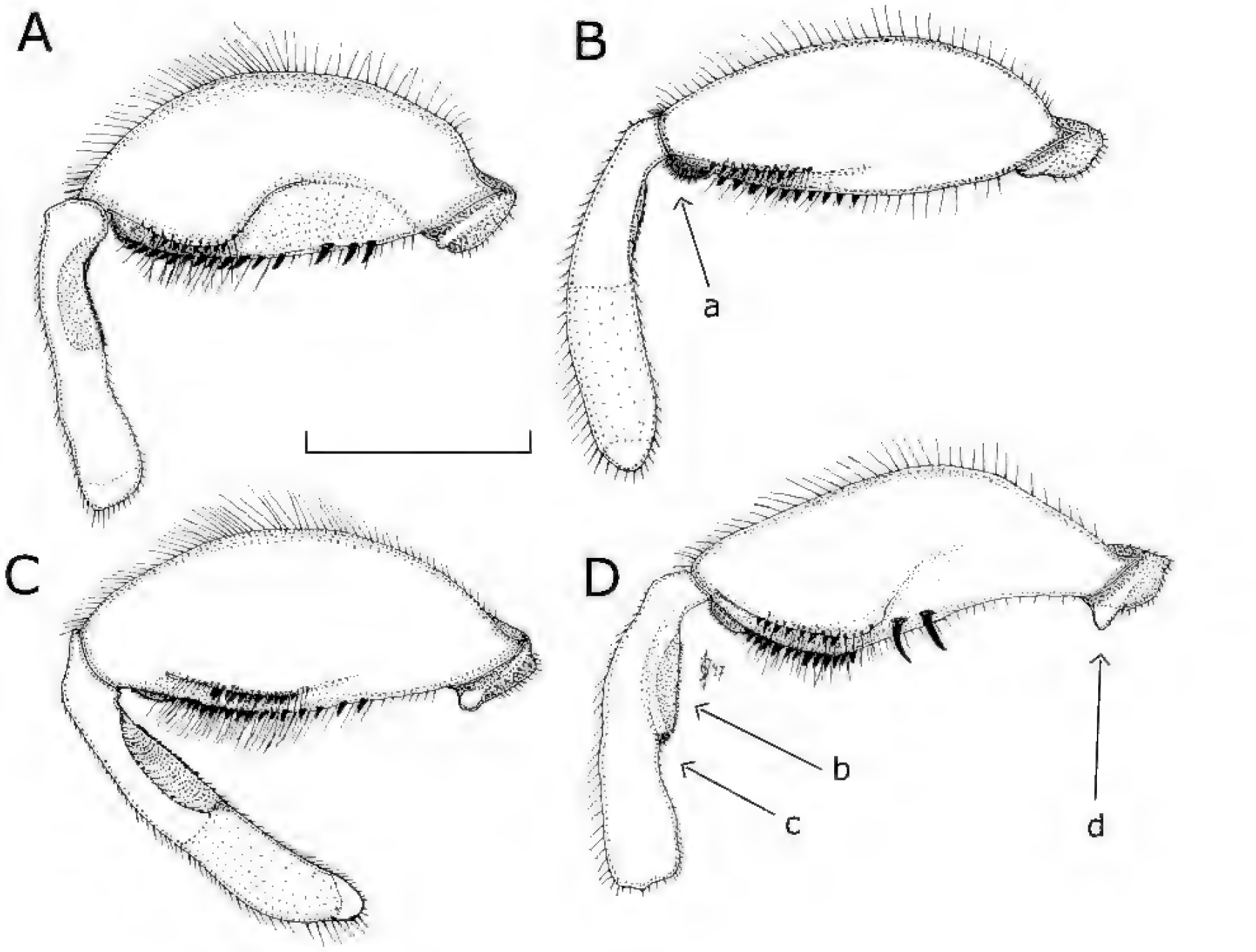

Fig. 7. Right metaleg (without tarsi) of ♂, anterior view. **A.** *Eumerus barbarus* (Sicily, Italy). **B.** *Eumerus gibbosus* **sp. n.** (Albacete, Spain, Paratype). **C.** *Eumerus schmideggeri* **sp. n.** (Saida, Algeria, Paratype). **D.** *Eumerus sulcitibius* (Albacete, Spain). Scale = 1 mm. a = apico-posterior lamina of metafemur, b = posterior lamina of metatibia, c = ventro-medial excavation of metatibia, d = process of metatrochanter.

de las Crucetillas road / C415 km 190, 1400 m [a.s.l.] / 38°31′NB 2°26′ WL / [leg] MP van Zuijen, J van Steenis / 21-6-2003 / dry pine forest, [on] yellow Apiaceae", 1 ♂ (MZW); "Spain(E) Albacete, Riopar, Cañada / de Provencio, 1000 m [a.s.l.] / 38°31′NB 2°20′ WL / [leg] MP van Zuijen, J van Steenis / 22-6-2003 / stream, open forest [on] yellow Apiaceae", 1 ♂ (JSA), 2 ♂♂ (MZW); **Portugal**: "PORTUGAL mal.trap / Mertola, west of town / dry rainwater brooklet / UTM: 29S 6171-4166 / 21-23.v.2004 [leg] A v. Eck", 1 ♂ (AET).

Eumerus schmideggeri sp. n.

Figs 1F, 1G, 2E 3F, 3G, 4F, 4G, 6F, 7C, 8C, 10C & 11C

Diagnosis. Pollinosity on ocellar triangle with two large oval maculae along eye margin (Fig. 3F); metafemur (Figs 7C, 8C) apico-posteriorly with hardly visible and scattered white pilose lamina; metatibia ventro-basally along medial surface with rather broad carina, posteriorly with rather broad lamina; pollinose maculae on terga very wide (Figs 1F, G); sternum IV (Fig. 10C) trapezoid, posterior margin concave with triangular posterolateral corners, narrow but deep medial incision. Genitalia (Fig. 11C): surstylus with small squarish medial part and straight apical part with rounded and slightly bent apex; hypandrium with narrow and straight apical part.

Description. MALE (Figs 1F, 2E). Body length: 8.4–9.3 mm, wing length: 5.5–6.3 mm. **Head**. Face nearly parallel sided. Frons light-grey pollinose, with scattered light yellow pile. Ratio width of head : width of face 2.8–3.0 : 1. Eye contiguity relatively short, ratio frons : eye contiguity : vertical triangle is as 1.4–1.6 : 1.2–1.3 : 1. Vertical triangle grey-yellow pollinose, broadly grey-yellow pollinose along eye margin and two broad squarish mac-

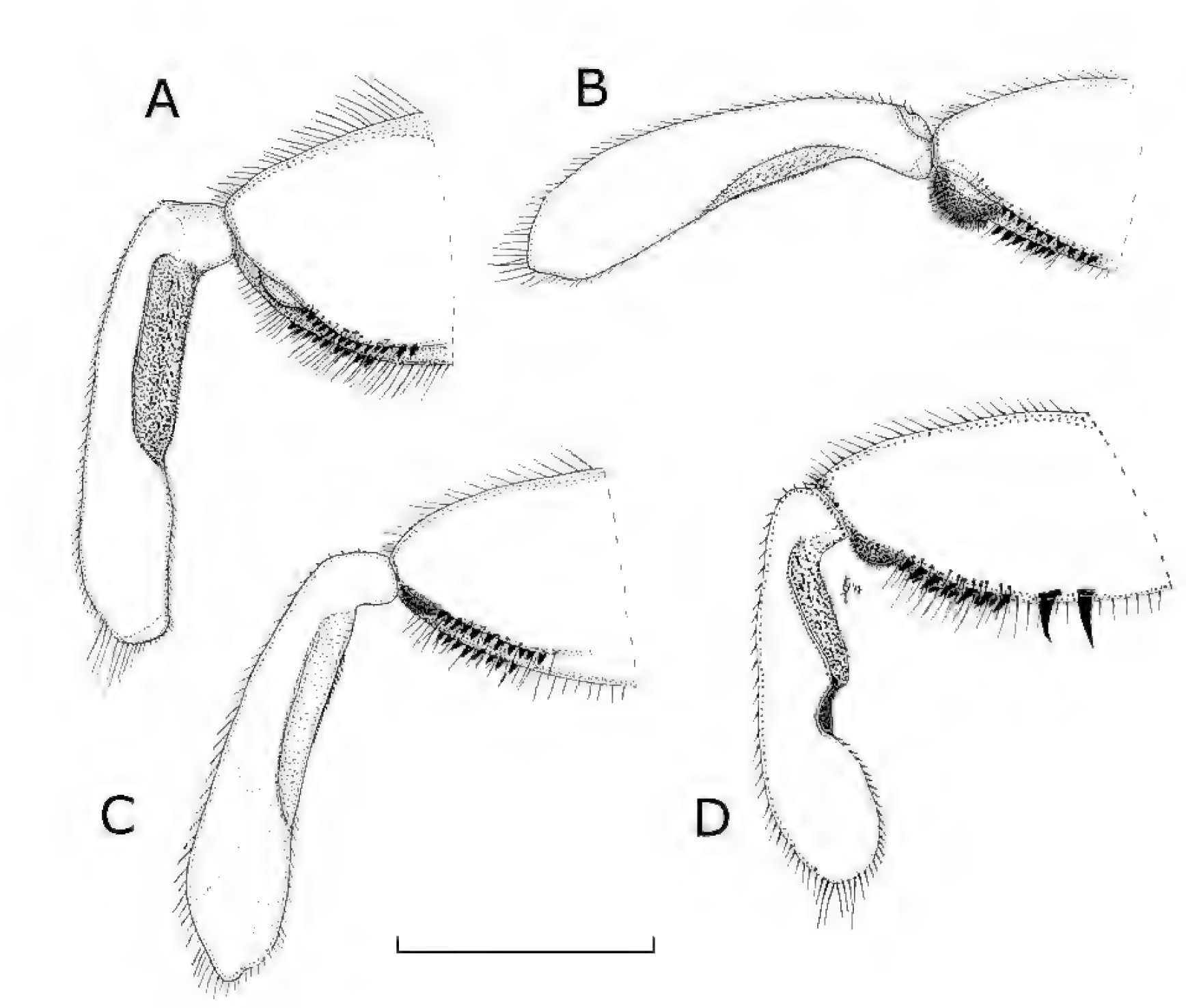

Fig. 8. Detail of left metaleg in ♂, posterior view. **A.** *Eumerus barbarus* (Corse, France). **B.** *Eumerus gibbosus* **sp. n.** (Holotype). **C.** *Eumerus schmideggeri* **sp. n.** (Saida, Algeria, Paratype). **D.** *Eumerus sulcitibius* (Albacete, Spain). Scale = 1 mm.

ulae posterior of ocelli, pile golden-yellow, on ocellar triangle entirely black pilose. Occiput predominantly grey pollinose, entirely white pilose. Ocelli isosceles with broad posterior base, length : width 1.2–1.3 : 1; posterior ocelli relatively far from eye margin, ratio width of frons : width of ocellar triangle 1.4–1.5 : 1; ratio a:b:c as 1.3–1.4 : 1.2–1.3 : 1; width of head : width of vertex is as 4.3–4.5 : 1. Antennae black to orange-yellow, scape black, pedicel from orange to black, basoflagellomere from entirely orange to yellow with apical half brown to dark-brown. Scape and pedicel with long yellow to black setae and light pile. Basoflagellomere (Fig. 6F) trapezoid, ratio length : width as 1.0–1.1 : 1 with anterior margin skewed ventrally. Arista with broad base, total length 2–3 times longer than basoflagellomere, basal 1/5 yellow to entirely black.

Thorax. Black bronze shiny, pollinose along lateral margin and posterior and anterior of notopleura, two mediolateral pollinose vittae reaching to posterior 2/3–3/4 of scutum, these pollinose vittae with broad triangular anterior part. Pile light yellow. Pleurae bronze black, pilose on proepimeron, postero-dorsal margin of anterior anepisternum, entire posterior anepisternum, anterior half of anepimeron and a dorsal and ventral pile patch on katepisternum. Grey pollinose on pilose parts, others bronze black sub shiny. Metasternum pilose. Scutellum rectangular with narrow marginal rim, shiny black with bronze sheen, golden yellow pilose.

Legs. Black and brown-yellow to orange coloured. Pro- and mesotarsus orange-yellow, connecting parts of tarsomeres black; pro- and meso tibia basal 1/2–2/3 orange-yellow and with apical black ring, sometimes with brow-yellow anterior part; apical 1/10 of pro- and meso femur brown-yellow. Pile all yellow with black setulae on ventral side of mesotarsus. Metaleg with coxa black and long white pile; trochanter brown-yellow to black, with short scattered mixed yellow and black pile, apicoventrally with short rounded tubercle (Fig. 7C); femur (Figs 7C, 8C) black, slightly enlarged, ratio length : width is 2.8–3.1 : 1, with normally curved ventral surface,

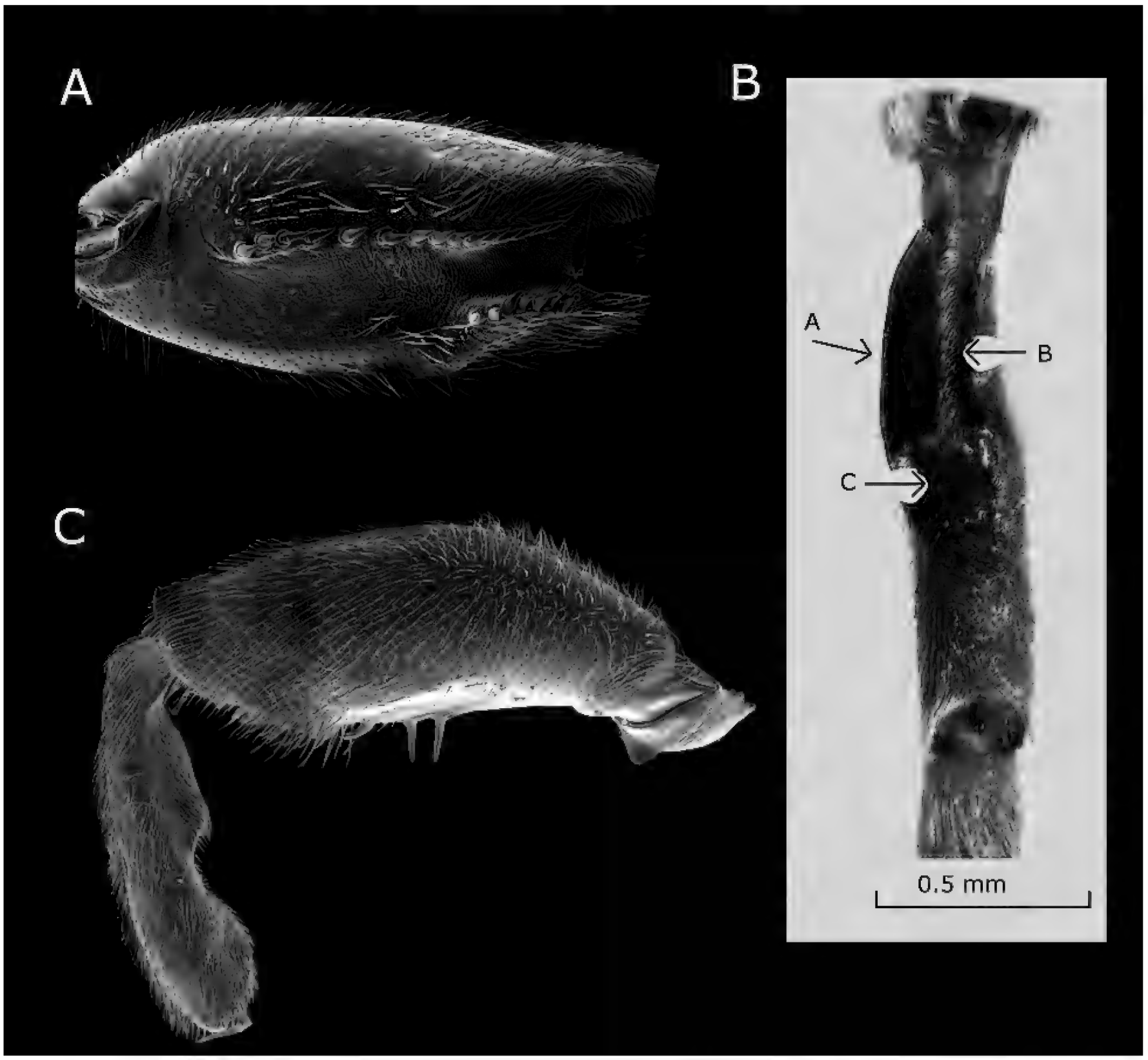

Fig. 9. Details of right metaleg of ♂. A, B SEM pictures; C Stack photo. **A.** Metafemur ventral view, *Eumerus barbarus* (Corse, France). **B.** Tibia ventral view, *Eumerus sulcitibius* (Albacete, Spain). **C.** Femur and tibia, anterior view, *Eumerus sulcitibius* (Saida, Algeria). A = posterior lamina of metatibia, B = medial carina of metatibia, C = ventro-medial excavation of metatibia.

covered with long white pile, antero-ventrally with a row of 8–10 black spinae apically and postero-ventrally with a row of 12–16 black spinae on apical 2/3, apico-posterior lamina large and densely dark brown pilose; metatibia orange-yellow on basal 1/2 and apical 1/10; only slightly curved, apically with antero-medial row of black dense spicules and posterior ventro-basally along medial surface with narrow carina; tarsus orange to dark-brown. **Wing**. Microtrichose except bare on medial part of alula and basally on cell bm and br. **Abdomen**. Shiny bronze black, white pilose, antero-medial part of terga II–IV with triangular area black to white pilose; terga II–IV with broad light-grey pollinose and slightly oblique maculae, medially slightly wider; sternum IV (Fig. 10C) trapezoid, posterior margin concave with triangular posterolateral corners, narrow but deep medial incision; sternum VI predominantly light yellow pilose; sternum VII predominantly light-yellow pilose. **Genitalia** (Fig. 11C). Surstylus with large rectangular basal part with large dorso-medial patch of setae; medial part squarish with baso-dorsal patch of setulae; apical part elongate with slightly rounded and slightly bent apex. Hypandrium with narrow and smooth apical part; hamus short and with small round apex.

FEMALE (Fig. 1G). Body length: 7.0–9.5 mm, wing length: 4.8–6.2 mm. Similar to male except for the usual sexual dimorphism. **Head** (Figs 3G, 4G). Ratio width of

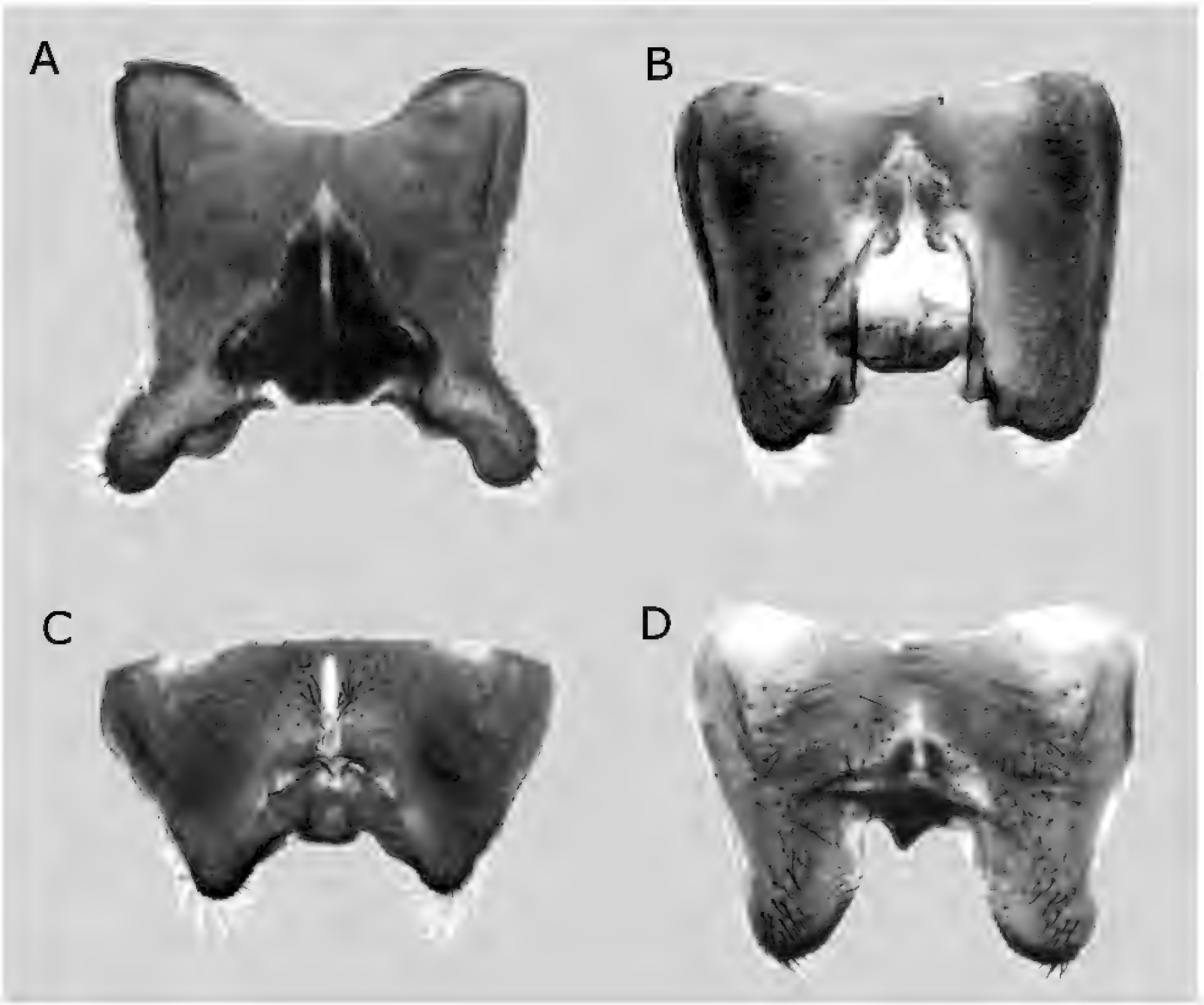

Fig. 10. Sternum IV ♂, ventral view. **A.** *Eumerus barbarus* (Bizerte, Tunisia). **B.** *Eumerus gibbosus* **sp. n.** (Holotype). **C.** *Eumerus schmideggeri* **sp. n.** (Holotype). **D.** *Eumerus sulcitibius* (Capri, Italy).

head: width of face 2.7 : 1. Ocelli isosceles with broad posterior base, width : length 1.3 : 1; ratio width of frons : width of ocellar triangle 1.9 : 1; width of head: width of vertex is as 3.5 : 1. Basoflagellomere oval with ventral part longer than dorsal, bright orange coloured with anterior 2/3 orange-brown, ratio length : width as 1.1 : 1. **Legs**. Metafemur black, slightly incrassate, ratio length : width is 2.9 : 1. **Abdomen**. Pollinose maculae oval-shaped, thick, occupying about 1/3 of length of tergum.

Etymology. Named after Christian Schmid-Egger, long-time friend, exceptional hymenopterist and avid insect collector, including the Holotype of this species.

Type material. HOLOTYPE ♂: **Morocco**: "Morocco, 37 km S Agadir / Sidi R'bat, 30.084 N 9.664 W / 30 m NN leg. Schmid-Egger / 17.06.2014 ma17" (ZMHB). **Paratypes**: **Morocco**: with same labels as holotype, 1 ♂ (JSA), 2 ♀♀ (CSCA); **Tunisia**: "Tunesien 21.6.2194 / Gafsa, Oasegarten / leg. Hauser, Tu-Gaf", 1 ♂ (CSCA); **Algeria**: "Dayet el Kerch / st 5. / 5 IV 1983", "Algerie / Saida / R. Leys & / P. v.d. Hurk", 1 ♂ (NBC); same labels except "5 km SE de Sfissifa / st. 8. / 6 IV 1983", 2 ♂♂ (JSA, MZW).

Eumerus sulcitibius Rondani, 1868

Figs 1H, 1I, 2G, 2H, 3H, 3I, 4H, 4I, 6G, 6H, 7D, 8D, 9B, C, 10D & 11D

Eumerus sulcitibius Rondani, 1868: 24. Type locality: Italy, Parma [Syntype ♂ MZUF, not studied].

Diagnosis. Metatrochanter ventrally with rather long and triangular process (Fig. 7D); metafemur (Figs 7D, 8D, 9C) ventro-medially with 2–3 large black spinae, clearly dif-

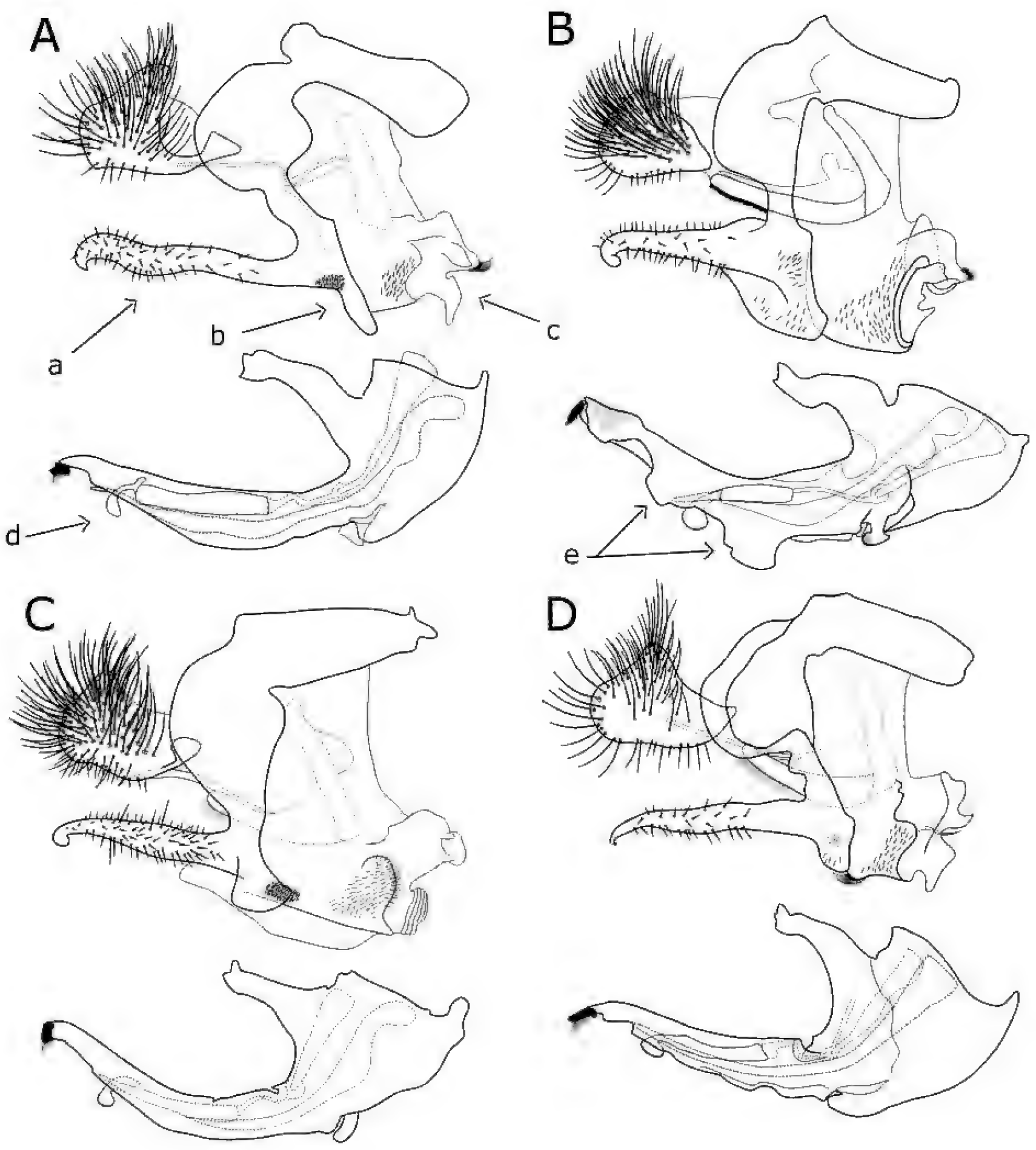

Fig. 11. Genitalia ♂, lateral view. **A.** *Eumerus barbarus* (Bizerte, Tunisia). **B.** *Eumerus gibbosus* **sp. n.** (Holotype). **C.** *Eumerus schmideggeri* **sp. n.** (Holotype). **D.** *Eumerus sulcitibius* (Capri, Italy). a = apex of surstylus, b = medial part of surstylus, c = basal part of surstylus, d = hamus, e = ventral surface of hypandrium (here with two "humps").

ferentiated from apico-ventral spinae; metafemur with narrow, light-brown pilose, apico-posterior lamina; metatibia ventro-medially with narrow but deep sulcus, metatibia (Fig. 9B) ventro-basally along medial surface with rather broad carina, ending medially in a deep excavation, posteriorly with broad lamina; sternum IV (Fig. 10D) rectangular with large broadly rounded postero-lateral corner and broad but not deep medial incision. Genitalia (Fig. 11D): surstylus with rectangular medial part; apical part elongate with slightly curved margins and with sharp, very weakly bent apex; hypandrium with rather narrow and slightly wavy apico-ventral margin.

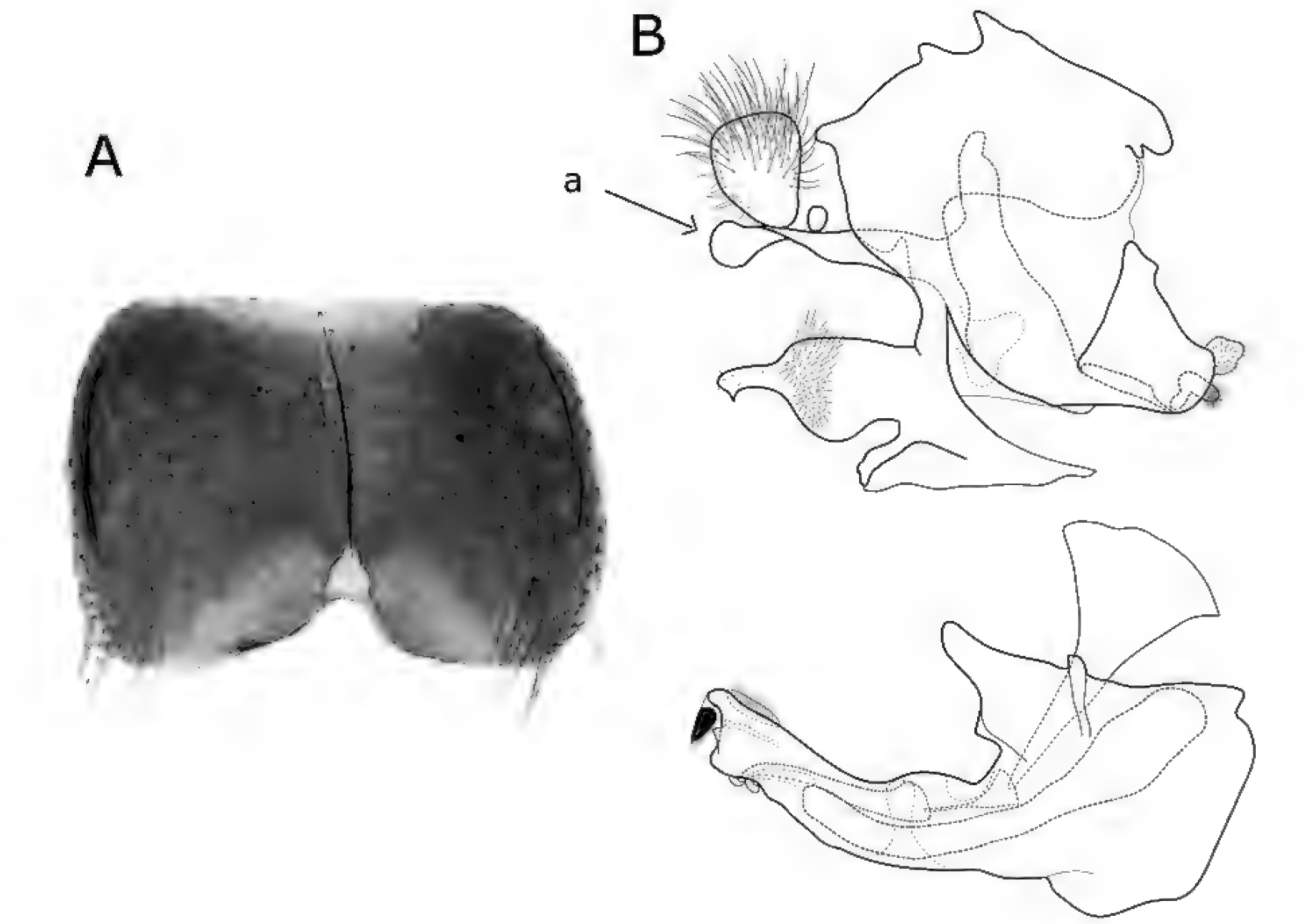

Fig. 12. *Eumerus truncatus* Rondani, ♂. **A.** sternum IV, ventral view (Ait-Baha, Morocco). **B**. Genitalia, lateral view (Ait-Baha, Morocco). **a** = teaspoon shaped appendix.

Redescription. MALE (Figs 1H, 2H). Body length: 7.2–8.5 mm, wing length: 5.9–7.0 mm. **Head** (Figs 3H, 4H). Face slightly triangular widening dorsally. Frons light-grey pollinose, with scattered light yellow pile. Ratio width of head : width of face 3.1–3.4 : 1; eye contiguity relatively long, ratio frons: eye contiguity : vertical triangle 1.3–1.6 : 1.4–1.6 : 1. Vertical triangle grey-yellow pollinose, narrow grey-yellow pollinose along eye margin and two short oval maculae posterior of ocelli, pile golden-yellow, on ocellar triangle ranging from yellow with some black pile intermixed to entirely black pilose. Occiput predominantly grey pollinose, entirely white pilose. Ocelli isosceles with broad base, ratio length : width 1.1–1.3 : 1; posterior ocelli relatively close to eye margin, ratio width of frons : width of ocellar triangle 1.2–1.4 : 1; ratio a:b:c as 1.2–1.4 : 1.2–1.3 : 1; width of head: width of vertex as 4.7–5.2 : 1. Antennae black to basally orange-yellow, scape and pedicel black, basoflagellomere from partly orange basally to entirely black. Scape and pedicel with long yellow to black setae and light pile. Basoflagellomere (Fig. 6G) rectangular, ratio length : width as 1.3–1.4 : 1. **Thorax**. Black bronze shiny, pollinose along lateral margin and posterior and anterior of notopleura, two mediolateral pollinose vittae reaching to posterior 2/3–3/4 of scutum, these pollinose vittae with broad triangular anterior part. Pile light yellow, posterior intermixed with longer black hairs. Pleurae bronze black, pilose on proepimeron, postero-dorsal margin of anterior anepisternum, entire posterior anepisternum, anterior half of anepimeron and a dorsal and ventral pile patch on katepisternum. Grey pollinose on pilose parts, others bronze black sub shiny. Metasternum pilose. Scutellum rectangular with narrow marginal rim, shiny black with bronze sheen, golden yellow pilose. **Legs**. Black and brown-yellow to orange coloured. Pro- and mesotarsus orange-yellow darkened ventraly, connecting parts of tarsomeres black; pro- and mesotibia basal 1/2–2/3 orange-yellow and with apical black ring sometimes with brow-yellow anterior part; pro- and mesofemur apical 1/10 brown-yellow. Pile all yellow with black setulae on ventral side of mesotarsus. Metaleg with coxa black and long white pile; trochanter brown-yellow to black, short scattered mixed yellow and black pile, ventrally with rather long and triangular process (Figs 7D, 9C); metafemur (Figs 7D, 8D, 9C) slightly less incrassate

compared with *E. barbarus*, length : width 2.9–3.3 : 1, medio-ventrally with 2–3 long and strong spinae clearly differentiated from apico-ventral rows of spinae, apico-ventrally with long white pile, antero-ventrally with a row of 8–11 black spinae apically and postero-ventrally with a row of 8–10 black spinae on apical 1/3, metatibia strongly curved, ventro-basally along medial surface with rather broad carina, ending medially in a deep excavation, posteriorly with broad lamina. **Wing**. Microtrichose, partly bare on cell bm and cup. **Abdomen**. Shiny bronze black, white pilose, antero-medial part of terga II–IV with triangular area black pilose; terga II–IV with light-grey pollinose and slightly oblique maculae, medially slightly wider; tergum IV predominantly black pilose, except lateral margin light yellow pilose; sternum IV (Fig. 10D) rectangular with large broadly rounded postero-lateral corner and broad but not deep medial incision; sternum VI predominantly light yellow to entirely black pilose; sternum VII from entirely white to mixed white and black pilose. **Genitalia** (Fig. 11D). Surstylus with small rectangular basal part with very scattered setae dorso-medially; medial part rectangular with a small patch of setulae medially; apical part elongate with slightly curved margins and with sharp but weakly bent apex. Hypandrium with rather narrow apical part with slightly wavy ventral margin; hamus long and with rounded apex.

FEMALE (Figs 1I, 2I). Body length: 7.5–9.2 mm, wing length: 5.9–6.8 mm. Similar to male except for the usual sexual dimorphism. **Head** (Figs 3I, 4I). Ratio width of head : width of face 3.0–3.3 : 1. Ocelli isosceles with broad posterior base, length : width 1.2–1.4 : 1; ratio width of frons width of ocellar triangle 1.7–1.9 : 1; width of head : width of vertex is as 3.8–4.1 : 1. Basoflagellomere (Fig. 6H) round, black to basally dark-orange coloured, ratio length : width as 0.95–1.0 : 1. **Legs**. Metafemur black, slightly incrassate, ratio length : width is 2.8–3.3 : 1.

Material studied. France: "France (Corse) / Asco (600-900) / 6-VII-1961 / HJP Lambeck", 1 ♂ (NBC); **Italy**: "Italy / Capri, Mt Solaro / 275-589m 25.VI.1992 / leg. P.W. Lohr", 1 ♂ (CSCA); "Italia / Sicilia / J.A.W. Lucas", "Taormina / 23-4-1976", 4 ♂♂, 1 ♀ (NBC); **Portugal**: "Portugal 260 m / Porto de Mos Alvados / UTM 29S0519-4377 / 12.IV.2007 leg A. van Eck", 1 ♂ (CSCA); **Spain**: "Espana / Avila / V.S. v.d. Goot / J.A.W. Lucas", "Sierra de Gredos / Navarredonda / de Gredos 1600 m / 9-7-1972", 4 ♂♂, 5 ♀♀ (NBC); "Spain, Albaceta / J. van Steenis & / M.P. van Zuijen", "Sierra de Alcaraz, 1200 m / Puerto de las Crucetillas / C 415 km 186 slope near / Populus plantation and small / stream 38°21′N 2°24′W / on *Thapsia villosa* 21-VI-2003", 2 ♂♂, 2 ♀♀ (JSA); "Spain (E) Albacete, Riopar / Puerto de las Crucetillas road / C415 km 190, 1400 m [a.s.l.] / 38°31′NB 2°26′ WL / [leg] MP van Zuijen, J van Steenis / 21-6-2003 / dry pine forest, [on] yellow Apiaceae", 1 ♂ (MZW); "Spain, Albaceta / J. van Steenis & / M.P. van Zuijen", "Sierra de Alcaraz / Batan del Puerto 1200 m / meadow in open Pine forest / 38°34′N 2°21′W / on *Thapsia villosa* / 21-VI-2003", 1 ♂, 2 ♀♀ (JSA), 1 ♀ (MZW).

Identification key to the species of the *Eumerus barbarus* group from western Mediterranean Basin

1. Males: eyes holoptic, genital capsule clearly developed (Figs 1A, 2C, 2G, 3A) 2
– Females: eyes dichoptic, genital capsule absent (Figs 1B, 2B, 3B) 5
2. Metafemur medio-ventrally with 2–3 long black spinae, clearly differentiated from the much shorter apico-posterior row of 8–10 spinae (Figs 7D, 8D, 9C), on apico-posterior corner with densely white pilose, narrow lamina (Fig. 8D); metatibia ventro-basally along medial surface with rather broad carina, ending medially in a deep excavation and posteriorly with broad lamina (Figs 7D, 8D, 9B, 9C); metatrochanter ventrally with rather long and triangular process (Figs 7D, 9)..... ***Eumerus sulcitibius*** Rondani, 1868
– Metafemur medio-ventrally without long black spinae, only with a row of rather short and stout black spinae (Figs 7A–C, 9A), with differently shaped and pilose apico-posterior lamina (Figs 8A–C); metatibia ventro-basally along medial surface with weak to broad carina, medial carina ending apically in at most a weak excavation (Figs 7A–C, 8A–C); metatrochanter ventrally with low tubercle or with short rounded process (Figs 7A–C) 3
3. Metafemur strongly incrassate, medio-ventrally with a broad and flattened scarcely pilose area, and apically with 5–8 black spinae antero-ventrally and a row of 14–22 black spinae postero-ventrally along nearly the entire length of the metafemur (Figs 7A, 9A); metafemur at apico-posterior corner with densely white pilose, narrow lamina (Fig. 8A); metatibia ventro-basally along medial surface with broad carina, posteriorly with very wide lamina (Figs 7A, 8A); sternum IV as in Fig. 10A, with two rounded projections postero-medially .. .. ***Eumerus barbarus*** (Coquebert, 1804)
– Metafemur slightly to clearly less incrassate, more evenly curved and almost entirely pilose, on apical part with 7–11 black spinae antero-ventrally and a row of 9–16 black spinae postero-ventrally along apical 1/2–2/3 (Figs 7B, 7C); metafemur at apico-posterior corner with densely brown pilose and wide lamina (Fig. 8B) or with scarcely pilose, hardly visible lamina (Fig. 8C); metatibia ventro-basally along medial surface with very narrow to at most rather broad carina, posteriorly with at most rather wide lamina (Figs 7B, 7C, 8B, 8C); sternum IV as in Figs 10B–C, postero-medial surface smooth 4

4. Metafemur medio-ventrally with an area with brownish pile; metafemur at apico-posterior corner with densely brown pilose, wide lamina (Fig. 8B); metatibia ventro-basally along medial surface with narrow carina, posteriorly with very narrow lamina confined to the most basal part (Figs 7B, 8B); terga with restricted pollinosity (Fig. 1D); sternum IV as in Fig. 10B ..... ***Eumerus gibbosus* sp. n.**
– Metafemur medio-ventrally with only light-yellow pilosity; metafemur at apico-posterior corner with scarcely pilose, hardly visible lamina (Fig. 8C); metatibia ventro-basally along medial surface with rather broad carina, posteriorly with rather broad lamina (Figs 7C, 8C); terga with extensive pollinosity (Fig. 1F); sternum IV as in Fig. 10C ..... ***Eumerus schmideggeri* sp. n.**
5. Oblique maculae on terga narrow (Figs 1B, 1E, 1I) .. 6
– Oblique maculae on terga broad (Fig. 1G) ..... ***Eumerus schmideggeri* sp. n.**
6. Metafemur postero-ventrally with a row of 4–10 evenly spaced spinae (similar to Figs 7A–C); basoflagellomere large, more oval about as wide as long (Figs 6B, 6E) 7
– Metafemur medio-ventrally with 1–2 spinae, differentiated from the other postero-ventral row of spinae (similar to Figs 7D, 8D); basoflagellomere large and round, almost wider than long (Fig. 6H) ..... ***Eumerus sulcitibius*** Rondani, 1868
7. Metafemur slightly incrassate (as in Fig. 3B); basoflagellomere large, oval (Fig. 6E); terga III and IV with pollinose maculae reduced, more or less straight (Fig. 1E) ..... ***Eumerus gibbosus* sp. n.**
– Metafemur strongly incrassate (as in Fig. 3A); basoflagellomere large, rounded (Fig. 6B); pollinose maculae on tergum III and IV large and strongly oblique (Fig. 1B) ..... ***Eumerus barbarus*** (Coquebert, 1804)

Excluded species from the *E. barbarus* group

Eumerus truncatus Rondani, 1868 stat. n.

Figs 1C, 2F, 3C, 4C, 6C, 12A–B

Eumerus truncatus Rondani, 1868: 575. Type locality: Italy, Sicily, Nebrodes [Holotype ♂, MZUF].

Diagnosis. Differing from the species of the *E. barbarus* group and *E. strigatus* by the following characters: squarish basoflagellomere (Fig. 6C) (in *E. strigatus* similar, in *E. barbarus* group more oval with rounded apico-dorsal corner), very slightly pollinose vertex (Figs 1C, 3C, 4C) (in *E. strigatus* similar, in *E. barbarus* group with dense pollinosity on apical corner and posterolateral from posterior ocelli); ocellar triangle with narrow base (Fig. 3C) (in *E. strigatus* slightly wider, in *E. barbarus* group with very wide base); mesonotum with hardly visible pollinosity, at most very narrow vittae mediolateral reaching to over 2/3 of scutum (Fig. 1C) (in *E. strigatus* and *E. barbarus* group with clear and wide medio-lateral pollinose vittae); metafemur apico-posterior normal, without lamina or pile fringe like in *E. strigatus* (in *E. barbarus* group with pile fringe and sometimes even with carina); water drop shaped to short straight pollinose maculae on tergum IV (Fig. 1C) (in *E. strigatus* and *E. sulcitibius* with nearly straight oblique vittae and in the other three species of the *E. barbarus* group with elongate lunulate maculae).

Redescription. MALE (Figs 1C, 2F). Body length: 6.6–6.9 mm, wing length: 4.5–5.1 mm. **Head** (Figs 3C, 4C). White pilose face and frons; mixed black and light-brown pile on vertex, with very scattered pollinosity in anterior corner; eyes white pilose; ratio width of head : width of face 3.1–3.3 : 1. Eye contiguity relatively long, ratio frons: eye contiguity : vertical triangle is as 1.1–1.3 : 1.1–1.2 : 1; ocelli isosceles with narrow posterior base, length : width 0.84–0.92 : 1; posterior ocelli far from eye margin, ratio width of frons : width of ocellar triangle 1.5–1.7 : 1; ratio a:b:c as 1.2–1.3 : 1.2–1.3 : 1; width of head : width of vertical triangle is as 4.0–4.6 : 1; basoflagellomere (Fig. 6C) dark-brown to orange squarish, ratio length : width as 1.1–1.3 : 1. **Thorax**. Shiny bronze with white pile. **Legs**. Colour predominantly black, only some tarsomeres and apex and bases of tibiae brown-yellow; metafemur slightly incrassate with white pile ventrally, the pile length about 2/3 of the width of femur and with normal vestiture of short black spinae apically, ratio length : width is 3.2–3.4 : 1. **Abdomen**. Abdomen shiny bronze with pairs of lunulate pollinose maculae on terga II and III and water drop shaped pollinose maculae on tergum IV, pile predominantly white; sternum IV (Fig. 12A) with straight posterior margin, medially with rather deep and broad notch; sternum VII mixed light-brown to black pilose. **Genitalia** (Fig. 12B). With characteristic teaspoon shaped appendix between cerci and surstylus; apical part of surstylus with large almost squarish base and suddenly narrowed, ventrally sharp tipped apex.

Material studied. Holotype ♂ *Eumerus truncatus*: "Maiorni", "147" [white oval label with red text], "Museo La Specola / coll. Rondani / HOLOTYPUS" [red label], "*Eumerus truncatus* / bona sp. / [det] Vujić 2014", "Holotype ♂ / *Eumerus truncatus* / Rondani, 1869 / det J. van Steenis, 2016" [red label] (MZLS).

Additional material. **Morocco**: "Marokko / Antiatlas / S. Ait-Baha / 12.III.1997 / 30°00′N 9°02′W / leg. M. Hauser", 3 ♂♂ (CSCA); "Marokko / 11km NW Taliouine / 15.III.1997 / 30°34′N 8°00′W / leg. M. Hauser", 1 ♂ (CSCA); "Morocco 25km NE Tizinit / Massa Riv. 29.890N 9.595W 30m NN / leg. Schmid-Egger / 16.VI.2014 mal15 GS", 2 ♂♂ (CSCA); "Morocco 20km E Tizinit / Assaka 29.960N 9.530W 190m NN / leg.

Schmid-Egger 16.VI.2014 mal16", 1 ♂ (CSCA); **Portugal**: "Portugal mal. trap Mertola / west of town / dry rainwater brooklet / UTM 29S6171-4166 / 21-23.I.2004 / leg A.v. Eck", 1 ♂ (AET); **Spain**: "Madrid / Arias Encobet", 1 ♂ (MNCN); "Belin chón (Cuenca) / 8-VII-1925 / J.M. Dusmet", 1 ♂ (MNCN); "Rio Peyales / Arena de San Pedro / 15.V-4.VI.1976 / 550 m Station 7", "España Avila / Sierra de Gredos / P. Oosterbroek & / E. Boersma", 1 ♂ (JSA); **Tunisia**: "Tunesia N Kasserine / 24.V.1999 1000 m asl / 35°25.14′N 08°44.74′E / leg. O. & M. Niehuis", 1 ♂ (CSCA); "Tunisia S M'Saken / 5 km N Sidi Bou Goubrine / 21.V.1999 ~ 1000 m amsl / 35°36.29′N 10°36.04′E / leg. O. & M. Niehuis", 1 ♂ (CSCA); "Tunesia S M'Saken / "Tunesie / J.A.W. Lucas", "Takrouana / 15-4-1977", 1 ♂ (NBC).

Remarks. In the synonymy of *E. barbarus*, *Eumerus truncatus* was mentioned (Pape & Thompson 2013). The latter is, however, a *bona species* clearly differentiated by the characters given in the above description. Grković et al. (2015) cited this species from eastern Mediterranean Basin (Crete, Lesvos and Naxos islands). The species is recorded from Morocco, Portugal, Spain and Tunisia for the first time.

DISCUSSION

The Mediterranean Basin is considered a biodiversity hotspot and ranked 15th out of the 25 world hotspots (Médail & Quézel 1999; Myers et al. 2000; Médail & Myers 2004) and, as such, in need for global conservation priorities (Sloan et al. 2014).

The family of Syrphidae has a high species diversity in the Mediterranean Basin (e.g. Kassebeer 2000, 2001; Vujić et al. 1999, 2001; Radenković et al. 2011; van Steenis & van Steenis 2014; Pérez-Bañón et al. 2016) but not many studies have included Syrphidae in analysis of biodiversity richness (Petanidou et al. 2013). The genera *Merodon* Meigen, 1803 and *Eumerus*, both dependent on bulbous plants in the larval and sometimes also adult stage and with often very specialized life cycle (Ricarte et al. 2008; Rotheray & Gilbert 2011), are key genera for species diversity in the Mediterranean Basin. The genus *Merodon* is well studied with many supposed Mediterranean endemics (Hurkmans 1993; Marcos-García et al. 2007; Vujić et al. 2007; Radenković et al. 2011; Popović et al 2015; Šašić et al. 2016). The genus *Eumerus* is less well studied and, besides the two newly described species in this paper, several studies indicate that there are many more new *Eumerus* species to be expected in the Mediterranean Basin (Grković et al. 2015; Chroni et al. 2017; Grković et al. 2017).

The Mediterranean Basin has many immediate and long-term threats that put in risk its biodiversity, such as increasing tourism and growth of population (Hoekstra et al. 2005; Cuttelod et al. 2008; Riservato et al. 2009). Restrictions in water, land and energy resources, and development of coastal tourism and urbanisation pose risks of further habitat degradation (Underwood et al. 2009). The predicted climate change will cause warmer summers and less precipitation during spring, autumn and summer (Lionello 2012) causing a general drying and possible desertification of the land. The warming of the Mediterranean Basin will be more than the world average making the global warming an even higher threat to this region. The decrease in precipitation combined with the increased demands of water for tourism, agriculture and the growing population lead to an even more rapid loss of natural water and drying of natural habitats, with an increasing risk for forest fires. All these factors influence the extant flora, with the bulbous plants as most valuable community of the Mediterranean Basin (Silva et al. 2008; Buerki et al. 2012; Mendoza-Fernández et al. 2015), and, consequently, all the species within the specialized genus *Eumerus* are highly threatened too. We believe that the description of these new species adds to the need for protective measurements and reappraisal of local refuges (Médail & Diadema 2009; De la Montaña et al. 2011; Vujić et al. 2016).

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George Bass, an early bird collector in the Pacific (1801–1802), and some notes on early bird collecting on the Pacific Ocean islands

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Abstract. The arrival of two living Samoan Fruit-doves *Ptilinopus fasciatus* on 7 June 1803 in the harbour of Le Hâvre, France with the return of one of the Baudin expeditionary vessels, the *Naturaliste*, marked the arrival of the first live birds from the tropical Pacific in Europe. More specimens from the tropical Pacific followed on 24 March 1804 when the second Baudin vessel, the *Géographe*, arrived at Lorient, France. The person responsible for collecting these birds was – most likely – George Bass (1771–1803), who donated these specimens to the expedition commanded by Nicolas Baudin at Port Jackson, Australia in November 1802. This paper documents Bass's bird collecting activities, his 1801–02 voyage, the role of the Baudin expedition and the Muséum National d'Histoire naturelle in Paris (e.g., donation, exchanges), and it documents the history of bird collecting in the tropical Pacific – on locations visited by Bass – pre-1823.

Key words. George Bass; Nicolas Baudin; Pacific; Birds; Australia; Cook Expeditions.

INTRODUCTION

George Bass (1771–1803) is a well-known explorer of Australia and to a lesser extent of the Pacific (Bowden 1952, Estensen 2005, 2009). Little has been published on his ornithological activities in Australia (pre-1800), and in the Pacific and New Zealand (1801–02). His connection with the expedition commanded by Nicolas Baudin to Australia (1800–1804) has been published (Bowden 1952: 113, Estensen 2005: 160–161, Starbuck 2009: 105, Jansen 2014, Jansen & van der Vliet 2015), in particular the merchandise he sold to the expedition (e.g., Bass sold pork, salt and other goods to the expedition). In addition, he donated 160 ethnographic artifacts when the expedition was moored in Port Jackson in November 1802 (Hamy 1906, Péron 1994: 159–167, Starbuck 2009: 171, 212). According to Horner (1987: 329), the number of artifacts was 206, however, this was the total number of artifacts collected during the entire Baudin expedition (Muséum d'Histoire naturelle Lé Hâvre, France, Ms21001; Starbuck 2009: 171). A part of the whaleboat in which Bass discovered Bass Strait was also given to the expedition (Bowden 1952: 68); its current whereabouts, as well as the ethnographical material he donated, are at present unknown. Ethnographical material was confiscated by Napoleon's wife, the Empress Joséphine de Beauharnais and incorporated into her private collection at her Malmaison estate, and subsequently destroyed in 1814 by invading troops during the final months of Napoleon's reign, while the rest was dispersed and sold in 1829 after Josephine's son Eugene de Beauharnais died (cf. Hamy 1906, Horner 1987: 329, Péron 1994: 224, Duyker 2006: 212, 289, Attenbrow 2010: 86, Fornaseiro *et al.* 2010: 355). Bass also donated notes to the Baudin expedition on the vocabulary and grammar of the "savages" at Port Jackson (Starbuck 2009: 171), as well as details regarding Bass Strait. Bass boarded the *Géographe* at least once for a visit, on 14 November 1802, in the company of Governor King and Captain Kent (Starbuck 2009: 102).

Until 1823 expeditions in the Tropical Pacific are few – but included those by Bougainville, Cook, Malaspina, Bruni d'Entrecasteaux, Vancouver, Krusenstern, Freycinet, Kotzebue (Brosse 1983) – but the first to make notable collections after the Cook expeditions was the *Coquille* in 1823 (Holyoak & Thibault 1982). This paper discusses the birds almost certainty collected by Bass during his Pacific travels and documents his early collecting in Australia.

Birds collected by Bass prior to 1801: We find the first evidence of Bass collecting natural history specimens in a letter written to his wife Sarah Bass (1798, State Library NSW, MLMSS 6544 / 6 letter 2). In this letter, he states his plans to accompany Mathew Flinders to Tasmania to collect natural history specimens for Joseph Banks and the Linnean Society in London (Whittell 1954: 40–46).

In a letter to the famed naturalist Joseph Banks (1743–1820) dated 27 May 1799 (State Library NSW, Series 72.005, CY 3682 11–14), Bass mentions, in describing his voyage during which he and Mathew Flinders discovered the Bass Strait: 'In the course of this expedition I collected at different times some few new subjects, both

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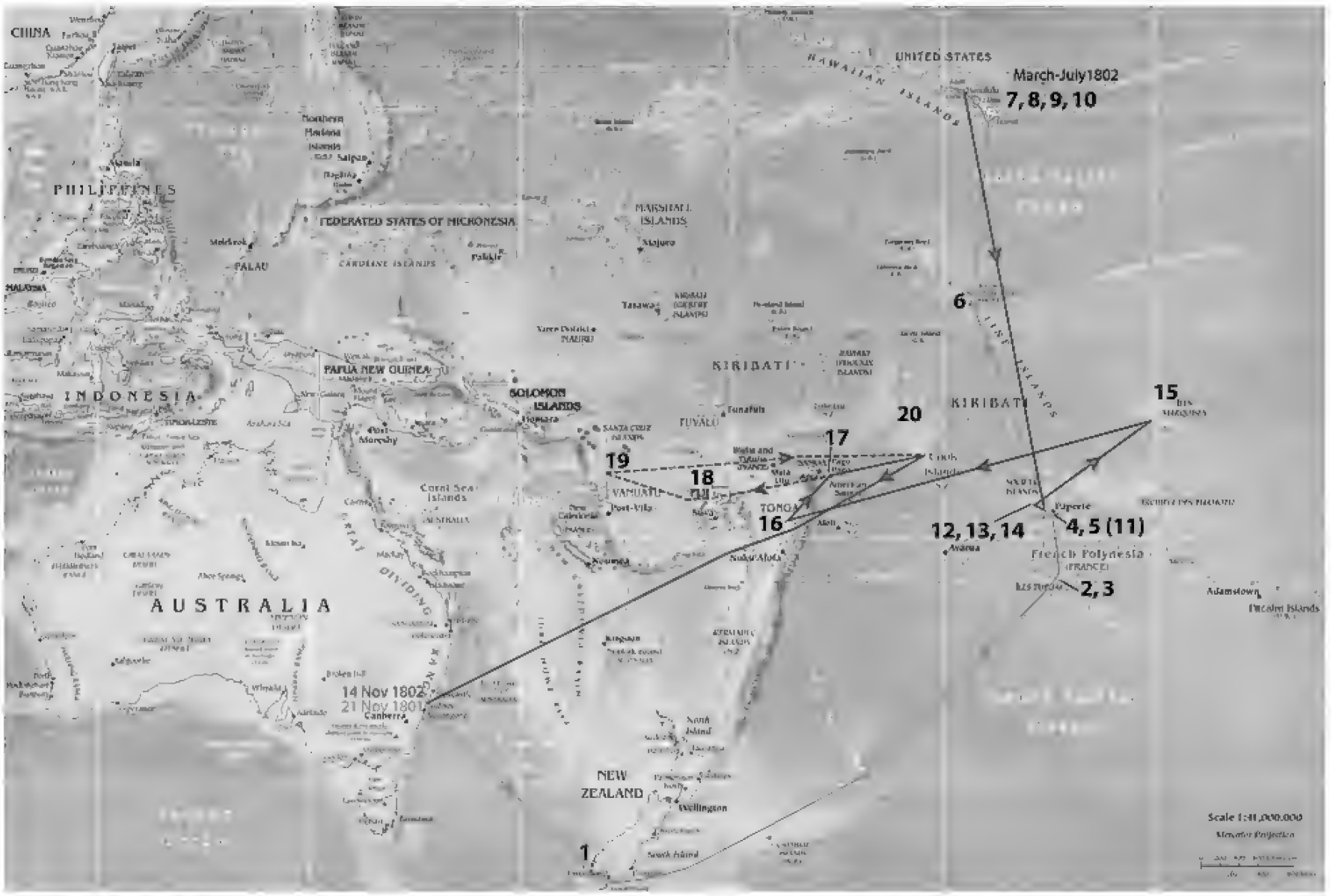

Fig. 1. Reconstruction of the journey made by George Bass between 21 November 1801 and 14 November 1802.

animals and plants; but they were from time to time destroyed by rain or by the seas which in bad weather the boat was constantly moving; so that none remained upon my arrival at Port Jackson'. With this letter, Bass also sent to Banks a skull of a Common Wombat *Vombatus ursinus* (Estensen 2005: 120, Pigott & Jessop 2007: 210), most likely collected west of Port Jackson, as well as skins of two birds: a Spotted Quail-thrush *Cinclosoma punctatum dovei* (described by Bass as a beautiful "banded runner" that had been chased and caught by a greyhound), collected in early January 1799 along the River Derwent in southeast Tasmania (Bowden 1952: 78, 83), and a Superb Lyrebird *Menura n. novaehollandiae* (described by Bass as a rare and new pheasant) (Bowden 1952: 83). The last is the bird mentioned by Collins (1804: 65) and Olsen (2001: 33) as the specimen collected along the Hawkesbury River near Port Jackson.

Bass regularly went out from Port Jackson in search of new or rare natural history specimens (Bowden 1952: 33). William Paterson, Lieutenant-Governor of New South Wales and a collector of natural history specimens for Banks, probably encouraged Bass's collecting activities, as both men knew each other and notes from Bass's observations on birds can be found in Paterson's diaries (cf. Bowden 1952: 66, 71–75, 78). Bass met Banks when in England in 1800, and presented Banks with some additional information on the items he had sent (it is unknown if Bass sent Banks more than one shipment of specimens). In the entry on Bass in the Australian Dictionary of Biography (http://adb.anu.edu.au/biography/bass-george-1748), Bowden mentions natural history publications by Bass, but unfortunately, I have not located them.

While at Port Jackson, Bass was made an associate member of the Society for Promoting Natural History, in

the same decade as Paterson (1755–1810) (who subsequently became a full member), John William Lewin (1747–1795) and botanist Robert Brown (1773–1858). The Society for Promoting Natural History was later merged with the Linnean Society (Neville 2012: 72).

In addition to the sites mentioned below, Bass could also have collected birds at Norfolk Island during visits in September–October 1796 and June–July 1798, New Caledonia and Tuvalu in June 1799, the Gilbert Islands (Abemama, Nonuti, Taputea), Marshall Islands and Mariana Islands in July 1799, Saint Helena in early 1800, as well as some other places visited during his voyages (Bowden 1952, Estsensen 2005, 2009).

Pacific Journey: Bass was contracted by Governor Philip Gidley King (1758–1808) to sail to Tahiti and transport salted pork back to Port Jackson, as food was scarce in Port Jackson but pigs were plentiful in Tahiti. From Port Jackson, Bass sailed into the Pacific on 21 November 1801 with Charles Bishop (1765–1810), and didn't return until 14 November 1802 (Bowden 1952: 106–113, Bowden 1980: 86–87, Estensen 2005: 149–161). In quotes below the supposed visits made by Bass (see Fig. 1).

Bass first landed at Dusky Sound, South Island, New Zealand (6–21 December 1801) (Anon. 1908a,b,c, Hamy 1906: 31–32, Péron 1994: 230–231, Bowden 1980, Rusden 2011: 415–416), and then proceeded on to the Austral Islands (Raivavae, Tubai) ('December 1801 or/and January 1802') (Estensen 2005: 150–151), Tahiti (24 January – 6 February 1802, 'July'–19 August 1802) (Anon. 1967, Anon. 1908b: 226, Hamy 1906: 30, Péron 1994: 229, Bowden 1952, Estensen 2005), Moorea ('February 1802') (Estensen 2005: 152), Kiribati ('February or/and March 1802') (Estensen 2005: 154), the Hawaiian Islands (Hawaii, Molokai, Kauai, Oahu) (11 March – July 1802) (see below), Moorea (August 1802) (Anon. 1967), French Polynesia (Huahine, Raiatea, Tahau (August 1802) (Bowden 1952: 112)), the Marquesas (island(s) visited unknown, 'August or/and September 1802') (Estensen 2005: 157), Tonga (island(s) visited unknown, 'September or October 1802') (cf. Hamy 1906: 30, Bowden 1980: 86–87, Péron 1994: 229), Samoa (Tutuila) ('September or/and October 1802') (cf. Hamy 1906: 28–32, Maude 1964: 262, Gilson 1970: 67, Pearson 1970: 140, Bowden 1980: 86–87, Linnekin 1991: 16, Péron 1994: 226–231, Tcherkézoff 2008: 73), (possibly) Fiji ('October 1802') (Bowden 1980: 86–87, Estensen 2005: 159), (possibly) Vanuatu ('October 1802') (cf. Bowden 1980: 86–87) and Cook Islands ('October or/and November 1802') (cf. Hamy 1906: 31, Péron 1994: 230). During Bass's stay in Tahiti, Lewin was also present (Neville 2012: 72–75).

Bass's visit to the Hawaiian Islands is notable. Documentation of his visit includes several letters (see Bowden 1980), including letters from Kealakekua Bay, Hawaii (George Bass to Sarah Bass, 20 May 1802, ZML MSS 6544, ML (Mitchell Library), Sydney) (Bowden 1980: 86–87, Estensen 2009: 154), Oahu (6 letters between Bass and James Innes) (the letters to Innes, who lived in Portsea (Hampshire), England, were sold at Christie's, London on 15 October 2009, then purchased by Hodern House, Sydney (an antique shop) and subsequently re-sold to a private collector (Matthew Fishburn in litt. 18 November 2014); one of the letters, dated 23 May 1802, was written by Bass at Waikiki Bay, Oahu), Kauai (Bowden 1980: 86–87) and Molokai (George Bass to Elisabeth Bass, 20 May 1802, ZML MSS 6544, ML, Sydney) (Estensen 2009: 151–153). Four ethnographic artifacts donated by Bass from the "Îles Sandwich" (= Hawaiian Islands) were listed as no. 74 and nos. 90–92 in the manifest of the ethnographic artifacts that returned with the Baudin expedition written by François Péron, the expedition's surviving zoologist (Hamy 1906: 30, Péron 1994: 229–230). Of special interest is no. 74, which Péron described as a "Grand pièce d'étouffe de plusieurs aunes de longueur en trois doubles, dont l'un noir, l'autre jaune, le 3e jaune strié de noir" ("Large piece of fabric several yards in length in three doubles, one black, the other yellow, the third streaked with black"). The striking colors indicate that this may have been a feather cloak made from the black and yellow feathers of the Hawaii Mamo *Drepanis pacifica* and Hawaii Oo *Moho nobilis*.

MATERIAL & METHODS

As part of an ongoing research into the bird collections made at the Baudin expedition (1800–1804), all known archival material and specimens brought back are researched (Jansen 2014, 2015, 2016, 2017a). For this, specimens were researched at: Università degli Studi di Firenze, Italy (C.G.U.); Muséum d'histoire naturelle Blois, France; Museum-Aquarium de Nancy, France; Muséum d'Histoire Naturelle de La Chaux-De-Fonds, Switserland (MHNC); Muséum d'histoire naturelle de la Ville de Genève, Switzerland (MHNG); Musée George Sand et de la Vallée Noire, La Châtre, France (MLC); Muséum national d'Histoire naturelle, Paris (MNHN); Naturalis Biodiversity Center, Leiden, Netherlands (Naturalis); National Museum of Scotland, Edinburgh, Scotland (NMS); Naturhistorisches Museum Wien, Austria (NHMW) and Museo di Zoologia, Università di Torino, Italy (MZUT). Additional information was gathered at the MNHN library, the Archives Nationales, Pierrefitte-sur-Seine, France; and in Muséum d'histoire naturelle du Havre, France. I further examined specimens and documents in the Linnean Society, London, UK; Natural History Museum, London, UK; Natural History Museum, Tring, UK; Musée Boucher-de-Perthes, Abbeville, France; Museum für Naturkunde Berlin, Berlin, Germany and Naturhistoriska riksmuseet, Stockholm, Sweden.

Fig. 2. MNHN 2005–2563, Samoan Fruit-dove *Ptilinopus fasciatus*: collected on Samoa, caught in 'September or October 1802' and shipped alive on the *Naturaliste*. It arrived alive in France at 7 June 1803, but died soon after. (Photograph by Justin J.F.J. Jansen, February 2015; © Muséum National d'Histoire naturelle, Paris.)

RESULTS

Arrival in Europe ana dispersal of specimens

Donation. When supplying the Baudin expedition (that visited Tenerife, Australia, Timor, Mauritius and South Africa), Bass donated to the expedition ethnographical items (see above), and the presence of birds from the same locations link them. These items were all shipped back later at the *Géographe*, but at least two live birds, a pair of Samoan Fruit-doves *Ptilinopus fasciatus* (Fig. 2) – most likely – collected by Bass, arrived with the *Naturaliste* (Jangoux *et al.* 2010). In addition to a variety of other live birds and mammals, the *Naturaliste* brought back 599 bird specimens according to Louis Dufresne, taxidermist at the Muséum national d'Histoire naturelle, Paris, France (2 August 1803, Archives Nationals AJ/15/590). Possibly because all the specimens that returned on the *Naturaliste* had already been packed (by Péron and Charles-Alexandre Lesueur) when Bass arrived back in Port Jackson only the two Samoan Fruit-doves arrived in France on the *Naturaliste* which sailed directly from Sydney to Le Hâvre with short stops only at King Island and Mauritius. The *Géographe* arrived in France in March 1804 with 422 bird skin specimens and 34 live birds (Dufresne inventory of 28 April 1804, *Collections Mammiferes et Oiseaux* MNHN).

Documentation. Several lists of the ornithological contents from both ships were compiled after the *Géographe* specimens arrived at the MNHN on 18 July 1804, joining the material shipped back on the *Naturaliste* that had arrived there in July 1803 (Burkhardt 1997: 505, Starbuck 2009: 213). Dufresne compiled three incomplete lists, one now in the *Collections Mammiferes et Oiseaux* in the MNHN (undated), one at the Muséum d'Histoire naturelle, le Hâvre (Ms 21036) (dd. 26 June 1804) and one in the Archives Nationales, Paris (AJ/15/592) (dd. 27 June 1804)

Fig. 3. MNHN 2014–432, Tui *Prosthemadera n novaeseelandiae*, collected at Dusky Sound, South Island, New Zealand, 6–21 December 1801, arrived at 18 July 1804 in France aboard the *Géographe*. (Photograph by Phil Koken, February 2015; © Muséum National d'Histoire naturelle, Paris.)

while a fourth list (undated), also in the *Collections Mammiferes et Oiseaux* MNHN, is probably a transcription by an unknown author (Jansen 2016). All four lists only identify the specimens by family and by the number of species and specimens, but do not identify the individual species within each family listed; moreover, they include only ten annotations of collecting localities. Even so, we find on these lists the collecting locality "d'otaiti", i.e., "from Tahiti", mentioned twice, first in the entry for "Grive nouveau" ("new thrush"), possibly the Society Island Flycatcher *Po-*

Fig. 4. MNHN A.C. 9818, Polynesian Triller *Lalage maculosa ssp*, collected in 1801–02 in the Pacific, arrived at 18 July 1804 in France on-board of *Géographe*. (Photograph by Justin J.F.J. Jansen, February 2015; © Muséum National d'Histoire naturelle, Paris.)

marea nigra (two specimens listed, both no longer present in the MNHN), annotated as "tres beau d'otaiti" ("very beautiful from Tahiti"). Tahiti is mentioned again in the entry for "Mycteria – Jabiru", probably referring to the Black-necked Stork *Ephippiorhynchus asiaticus australis* of Australia (one specimen), annotated with "et un bec d'otaiti" ("and one beak from Tahiti"), the origin of the latter species apparently misidentified (list in *Collections Mammiferes et Oiseaux* MNHN). Included in the list of live animals brought back on the *Naturaliste* were "Tourterelles des iles des Navigateurs" ("Turtledoves from the Navigator Islands") (cf. Jangoux *et al.* 2010: 271, 281). Both turtledoves and fruit-doves were referred to as "tourterelles" at that time (cf. Buffon 1765–1783: plate 142). The only pigeon present to date in MNHN (Fig. 2) from the 'iles des Navigateurs' (= Samoa) is a single Samoan Fruit-dove, the pedestal underside confirms its origin (arrived in An XI = via the *Naturaliste* according to Louis Dufresne on the pedestal underside). These specimens, of the "Grive nouveau" and the "Tourterelles des iles des Navigateurs", almost certainly came from Bass, as the Baudin expedition did neither visit Tahiti nor Samoa. However, crew-member Hyacinthe de Bougainville, mentioned as origin the Sandwich Islands (de Bougainville, Archives nationales de France, 155 AP6).

The Birds. Bass most likely collected four specimens of birds presently in the MNHN; however, as all four lack their original labels (which applies as well to all specimens (1000's) in the MNHN acquired prior to 1850), their origin remains speculative. The four specimens are: two Tui *Prosthemadera novaeseelandiae* (only one, registered as MNHN-ZO-2014-431, is still present (Fig. 3); the other has not been located by me but it is noted in the acquisition books and was present in 1856), most likely collected by Bass at Facile Harbour, Dusky Sound, New Zealand between 7–21 December 1801 (its origin is documented in the pedestal underside that mentions "Nouvelle Zélande / La Découverte an 12 / Peron et Lesueur / No 80 / 10116 / *Prosthemadera novaezeelandiae* / Gm); Samoan Fruit-dove (MNHN-ZO-2005-2563, Fig. 2), collected by Bass in Samoa in 'September or October 1802' (this is one of the two captive Samoan Fruit-doves noted above that arrived on the *Naturaliste* in 1803; the other is no longer present in the MNHN) (Jangoux *et al.* 2010: 271, 281)); and Polynesian Triller *Lalage maculosa* (MNHN-ZO-2016-523, Fig. 4, a skin that was mounted before) (its new label mentions "Exp Baudin / Ex. Peron et Lesueur / "*Lalage Pacifica*"), was collected on an unspecified Pacific locality. Also, on 27 March 1805 a parakeet from Tahiti was 'sold' to Dufresne, for his private collection (Archives Nationales AJ/15/593).

The notes at the Pigeon and Tui are from Louis Dufresne's hand, who mounted birds that arrived in the museum to be used for the galleries almost directly after arrival in the museum (Archives Nationales AJ/15/592 & 593, Jansen 2016). This makes these specimens amongst the best-documented birds from the tropical Pacific collected pre-1823 (Medway 2004). All other Pacific birds in European collections lack their original label, and only very few are proven to be collected from the Tropical Pacific before 1823 (Burton 1968, Medway 2004, Steinheimer 2005).

Exchanges

Only half of the 1.055 specimens (all skins) that arrived with the Baudin expedition were mounted for exhibition in the MNHN galleries and about 397 are still present in European collections (Jansen 2017a). The remainder – especially those birds that arrived on the *Géographe* – were used for exchanges and donations (Jansen 2014, 2016, Jansen & van der Vliet 2015). It is uncertain how many bird specimens were in good condition upon the expedition's return, considering that the ships were probably infested with swarms of cockroaches and rats (Laurent 1997), or how many deteriorated soon after their arrival in France, noted is that some had to be thrown away (Louis Dufresne, 7 May 1811, Laboratory MNHN).

No less than 178 birds were disposed of Empress Josephine (Geoffroy at 23 September 1804, Archives Nationales AJ/15/593) (93 birds from the *Naturaliste* and 85 birds from the *Géographe*, most likely donated in two shipments). Donations were made to schools in Rouen and Moulins (Jansen 2014, 2016, 2017a) and to Vienna in 1815 as partial repayment or material looted during the Napoleonic Wars (Bauer & Wagner 2012; Archives Nationales France, AJ/15/840). Baudin specimens were also probably amongst the 847 birds donated to the Netherlands for the same reason (Archives Nationales France, AJ/15/840) (Jansen 2016: 104).

Most specimens that arrived on the *Géographe* were purchased by or donated to the Baudin expedition, as estimated by 93 specimens from *Géographe* still at the MNHN; only 23 birds of which were collected in Australia, a large portion originated from countries not visited by the Baudin expedition, for example: Sumatra, Java, Celebes, Madagascar and India. It is unknown how many birds, from the total number that arrived on the *Géographe*, originated with Bass. That all these precious specimens left the MNHN was primarily due to the lack of an ornithologist as curator of the bird collection. At that time a visitor, the clerk of *Bulletin des Lois*, Louis Vieillot, described a portion of the birds brought back as new birds (cf. Mearns & Mearns 1998: 133–134).

The speed with which new specimens were dispersed is shown by the purchase of 30 skins in 1806 by Leopold von Fichtel from John Latham; these birds, currently in Naturhistorisches Museum Wien, Vienna, Austria, were collected at Dalrymple Bay, Tasmania in April 1802 (Autogr. 21/35 L.v. Fichel, Österreichische Nationalbibliothek, Vienna, Austria) (Bauernfeind 2004: 557), an area visited by the Baudin expedition in March–April 1802 (*Naturaliste*). The area was also visited by Robert Brown on 1–17 January 1804 (cf. Vallance *et al.* 2001; Jansen 2014), who collected two bird specimens there (NHMUK London, Brown, M.S. Descriptions Animals HMS *Investigator* 1801–1805. Aves). From these two specimens for one its whereabouts remain unknown (one was donated to Linnean Society in 1818 (list in Linnean Society (S.P. 156) and a typed version of the BM donation in NHM, London (NHM London, Brown, M.S. Descriptions Animals HMS *Investigator* 1801–1805. Aves)). So, part of these Dalrymple Bay specimens have (if the rumoured date is correct) – most likely – originated from the Baudin expedition (visited by the *Naturaliste* in April 1802), the other from William Paterson who resided here for a few years between 1804 and 1809.

Other specimens ended up in the private collection of Coenraad Jacob Temminck, then a private collector, and later his collection formed the nucleus of the collection we now know as Naturalis Biodiversity Center, Leiden. In his collection six pacific specimens arrived between 1803–04 and 1807 and was enlarged to 22 specimens (Jansen 2017b: 353), and amongst them is a Tonga Fruit-dove *Ptilinopus porhyraceus* (RMNH.AVES.213951) (maybe this is the other 'Samoan Fruit-dove' shipped alive on the ship *Naturaliste*). But a fair number ended up in numerous other collections in Europe (see for more details Jansen 2017a).

Some specimens from the Baudin expedition may also have been among specimens from MNHN that entered the Lever Museum in London (Jansen & van der Vliet 2015).

DISCUSSION

We find various bird specimens from the tropical Pacific and New Zealand collected prior to 1823 (appendix 1) in older collections (e.g., Berlin, Cambridge (USA), Edinburgh, Göttingen, Hannover, Leiden, LIVCM, MNHN, Stockholm, NHM, Turin, Vienna) that are still in good condition, probably due to their having been treated with arsenic soap either when they were collected or upon their arrival in Europe (the recipe for arsenic soap was known to the French and a few others like C.J. Temminck and François Levaillant (cf. Steinheimer 2003, Jansen & Roe 2013, Jansen & van der Vliet 2015)). Few expeditions and/or collectors are known to have been active in the locations visited by George Bass (see appendix 1).

In this paper, it has been shown that: 1) George Bass has been neglected as a natural history collector; 2) There is evidence that he had direct links with the Baudin expedition, as for ethnographical material (proven) also ornithological material could be donated to the expedition and eventually ended up in the MNHN; 3) Few, if any, extant pre-1823 bird skins are unambiguously attributable to specific collectors, due to inadequate labelling; 4) However, locality information and known routes of Baudin and of Bass suggest Bass probably collected some skins that were taken to France; 5) The fate of Bass's now poorly-documented specimens illustrates the problem of determining the provenance of tropical Pacific specimens that were circulating in Europe in the early 19th century.

I encourage further research to find missing documents and to locate additional information of tropical Pacific and Australian specimens collected by George Bass.

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APPENDICES

PREVIOUS COLLECTING IN LOCATIONS VISITED BY BASS (1766–1823)

To establish the importance of the collecting carried out by Bass, I analysed ornithological collecting activity up to the early 1800s in the order of the countries visited by Bass. Up to 1823 expeditions in the Tropical Pacific are few and the first large expedition was the *Coquille* in 1823 that visited the region (Holyoak & Thibault 1982).

Australia: See Jansen (2017a).

New Zealand: Cook landed at New Zealand during all three expeditions (cf. Lysaght 1959; Whitehead 1978), and 8 specimens from New Zealand are known from Banks's private collection (Medway 1979). Although few Cook specimens are still extant (Burton 1968; Medway 2004), specimens known or alleged to have been collected in New Zealand during the Cook expeditions are (or were) still present in Cambridge (USA) (Paradise Shelduck *Tadorna variegata* (1788 collected) not present anymore, according to http://mczbase.mcz.harvard.edu/SpecimenSearch.cfm, accessed 6 June 2015), NHM (three birds), Leiden (three birds) and Liverpool Museum (hereafter LIVCM), (four birds) (cf. Steinheimer 2003). The next expedition to New Zealand was with the *Recherché* and *Espérance* (apparently, no birds collected in New Zealand, cf. Stresemann 1953b). Captain A. Malaspina landed in 1793 in New Zealand, but none of his specimens entered museums and none have survived (Olson 2006). The *Coquille* visited New Zealand in April/May 1825 and approximately 50 birds were collected (MNHN Library, Ms 354). The *Astrolabe* took 11 New Zealand birds back to France.

Raivavae: Although Cook sighted this island on his third expedition; he did not land there (Brosse 1983).

Tubai: Cook also sighted this island on the third expedition, but did not land there either (Brosse 1983).

Kiribati: Cook described this island after a possible visit on 24 December 1777, during the third expedition (Brosse 1983).

Tahiti: Cook visited Tahiti during all three expeditions (Brosse 1983); at least 15 birds from Tahiti were recorded in Banks's private collection (Medway 1979). It is unknown if birds are brought back to Europe/Russia by the frigates *Boudeuse* and *L'etoile* (captained by L.A. de Bougainville, 1766–69, cf. Laissus 1978) and the ships *Predpriyatiye* (captained by O. von Kotzebue, 1823–26), *Blossom* (captained by F.W. Beechey, 1825–1828, cf. Beechey 1839, no Pacific specimens are reported in here), *Vostok* and *Mirny* (captained by F. Bellinghausen, 1819–1821) and *Senyavin* (captained by F.P. Litke, 1826–1829). At least 36 birds collected in Tahiti during the visit of the *Coquille* arrived in the MNHN in 1829.

Moorea: Cook visited Moorea on the third expedition (Brosse 1983).

Hawaiian Islands: Visited by Cook during the third expedition; at least 53 birds collected in Kauai and Hawaii ended up in Banks's private collection (Medway 1979) and were subsequently dispersed, as were Hawaiian birds from the Cook expedition deposited in other collections (cf. Steinheimer 2003; Jansen & Roe 2013). The ship *King George* (captained by N. Portlock) was mainly at Oahu from 26 May to 13 June 1786, that resulted in an unknown number of specimens arrived in England (cf. Dixon 1789; Olson & James 1994). From the *Uranie* voyage, 9+ birds were collected in August 1819 (Hawaii, Oahu) (archives MNHN). The ship HMS *Blonde* (captained by G.A. Byron) visited various islands in May–July 1825 and collected 21 bird species (Callcott *et al.* 1826: 248–252). The ships *Nadezhda* and *Neva* (captained by A.J.R. von Krusenstern) the brig *Rurik* (captained by O. von Kotzebue, 1815–1818) expeditions visited the islands, but apparently, no birds made their way back (maybe from the later via J.J. Dussemier to the MNHN). Birds may have been collected when the *Blossom* visited Oahu in 1826 (Brosse 1983), but no Hawaiian specimens are mentioned in Beechey (1839).

Huahine: Visited by all three Cook expeditions (Brosse 1983).

Raiatea: Visited by the second and third Cook expeditions (Medway 1979); at least eight birds from these expeditions were in Banks's private collection (Medway 1979).

The Marquesas: Visited by the second Cook expedition (Brosse 1983). A lone bird was brought back by *Nadezhda* and *Neva* (Holyoak & Thibault 1982).

Tonga: Visited by the second and third Cook expeditions (Brosse 1983). No less then 40 birds from Tonga are known from Banks's private collection (Medway 1979). In 1793, *Recherché* and *Espérance* (1791–1794) brought some birds back to France (at least five birds, Stresemann 1953). Commander Malaspina landed in Tonga in 1793; some birds were collected, but they were neglected and have vanished (Olson 2006: 43). The *Astrolabe* expedition collected 51 birds in Tonga in 1827 (inventory of 520 birds that arrived back from the whole expedition from 25 May 1829, MNHN Ms 2223).

Notable is the description from at least one living Tonga Fruit-dove by Robert Brown brought back on the HMS *Investigator* in 1805 to England, however it "Died from cold on the HMS *Investigator* on crossing from New Wales to England" as mentioned by Brown (NHM London, Brown, M.S. Descriptions Animals HMS *Investigator* 1801–1805. Aves. No 196). This bird is not on the list of donations of his 78 specimens in both the British Museum as to the Linnean Society of London, so it's whereabouts are unknown. Its source is unknown, it is not George Bass, as both men did not meet in Bass's stint in Sydney after returning between November 1802 and February 1803 from the Pacific (Brown returned at 9 June 1803 to Sydney).

Samoa: The islands were visited by the ships *Predpriyatiye* (1823–26) and *Uranie* (1819) but no known birds were brought back (Brosse 1983).

Fiji: Visited by the second Cook expedition (Brosse 1983). One bird was collected on the *Astrolabe* expedition (inventory of 520 birds from 25 May 1829, MNHN Ms 2223).

Vanuatu: Visit at the second Cook expedition, *Recherché* and *Espérance* as the *Astrolabe* (1826–1829) expeditions, but no known specimens were brought back (cf. Brosse 1983).

Cook Islands: Apparently, a single bird was collected here in 1798 by HMS *Discovery* (captained by G. Vancouver, cf. Holyoak & Thibault 1982). HMS *Blonde* visited Mauke in August 1825, and collected were a kingfisher, a pigeon and a starling (Olson 1986).

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A new species of *Meoneura* Nitzsch from Japan (Diptera: Carnidae)

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Abstract. A new species of the genus *Meoneura* (Diptera: Carnidae), i.e. *Meoneura issunboshii* sp. n., is described from Japan.

Key words. Diptera, Carnidae, *Meoneura*, sp. n., Japan.

INTRODUCTION

The family Carnidae is a member of the superfamily Carnoidea (Diptera: Schizophora: Acalyptratae). The flies are only up to 2 mm long and mainly black. Due to the similarity to several other, more common acalyptrates, Carnidae are recognised only by experts and are easily overlooked in samples. The larvae of Carnidae are saprophagous and develop in various kinds of dead organic material as dung, birds' nests or fungi. To date only five extant and one fossil genera are recognised. Carnidae comprise 116 valid species distributed as follows: 10 Afrotropical species, 26 Nearctic species, 6 Neotropical species, 14 Oriental species, and 77 Palaearctic species (Brake 2011, Stuke unpublished). The highest number of species is known from Europe (52 species; Brake 2011, Stuke unpublished), probably as a result of the long history of dipterological research, and it is very likely that the lack of Carnidae described from the Eastern Palearctic Region, and the low number of species recorded from this region, is a result of a comparably poor collecting activity.

Only three Carnidae species are reported from Japan so far. Iwasa et al. (2000) recorded *Carnus hemapterus* Nitzsch, 1818 from Fukagawa (Hokkaido), and Iwasa et al. (2014) found *Carnus orientalis* Maa, 1968 from Kunigami, (Okinawa). Tago (2011) reported *Meoneura triangularis* Collin, 1930 from Tokio, representing the first record of this genus from the region. With 98 valid species, *Meoneura* Rondani, 1856 is the genus of Carnidae with the largest number of species worldwide. Due to an excellent drawing of the male genitalia provided by Tago (2011), it became evident that this was a new species and is herewith described in this study.

MATERIALS AND METHODS

All material reported here was previously published by Tago (2011), later sent to and examined by JHS. The abdomen of three male and two female specimens were dissected, macerated for about three hours in $NaOH_{(aq)}$ solution and stored in a microvial in glycerine together with the specimen on the insect pin. The morphological terminology follows Cumming & Wood (2009) and Buck & Marshall (2007). The terms that are used to describe the postabdomen are additionally illustrated in Figures 1–3. A separate sclerite, ventrally beneath the protandrium (syntergosternite 6–8 *sensu* Wheeler 2010: 1102, Fig. 5), is recognised as tergite 7 (Buck & Marshall 2007: 14, Fig. 16). The most anteroventral seta on the face is interpreted as the vibrissa, those above the vibrissa as supravibrissal setae, and those posterior to the vibrissal seta on the gena as genal setae. The labels of the holotype are listed and numbered in the order found, commencing with the uppermost. The original content of the label information is cited between double quotation marks (") and line breaks are indicated by a slash mark (/).

Digital images were taken using a Zeiss Axioskop 40, Zeiss A-Plan 10x / 0.25 Ph 1 Var1 with a Nikon D7000 mounted on a Zeiss 45 60 05 2.5 x. The pictures were used as template and the drawings were made with Affinity Designer 1.6.0 on Wacom DTZ -1200W.

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DESCRIPTION OF THE NEW SPECIES

Meoneura issunboshii sp. n.

Figs 1–4

Meoneura triangularis Collin, 1930. Tago (2011).

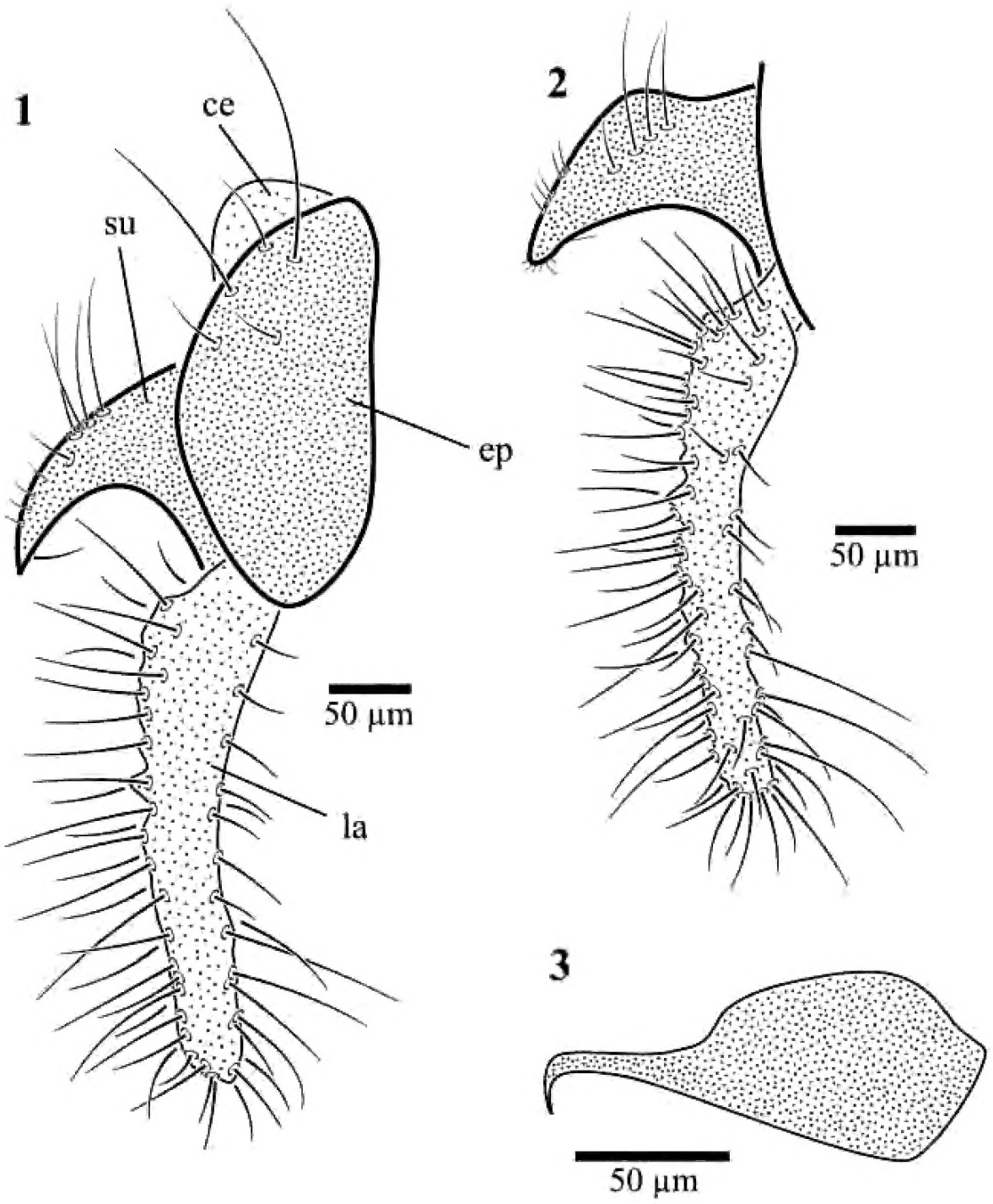
Diagnosis. Males of *Meoneura issunboshii* sp. n. are easily identified by the unique shape of the falcated surstylus with 4–5 dorsal setae (Fig. 2), the characteristic large lamella (larger than surstylus) covered with long setae (Figs. 1–2), and the short epandrium (shorter than surstylus, Fig. 1). Females of *Meoneura issunboshi* sp. n. cannot be identified at species level with morphological characters.

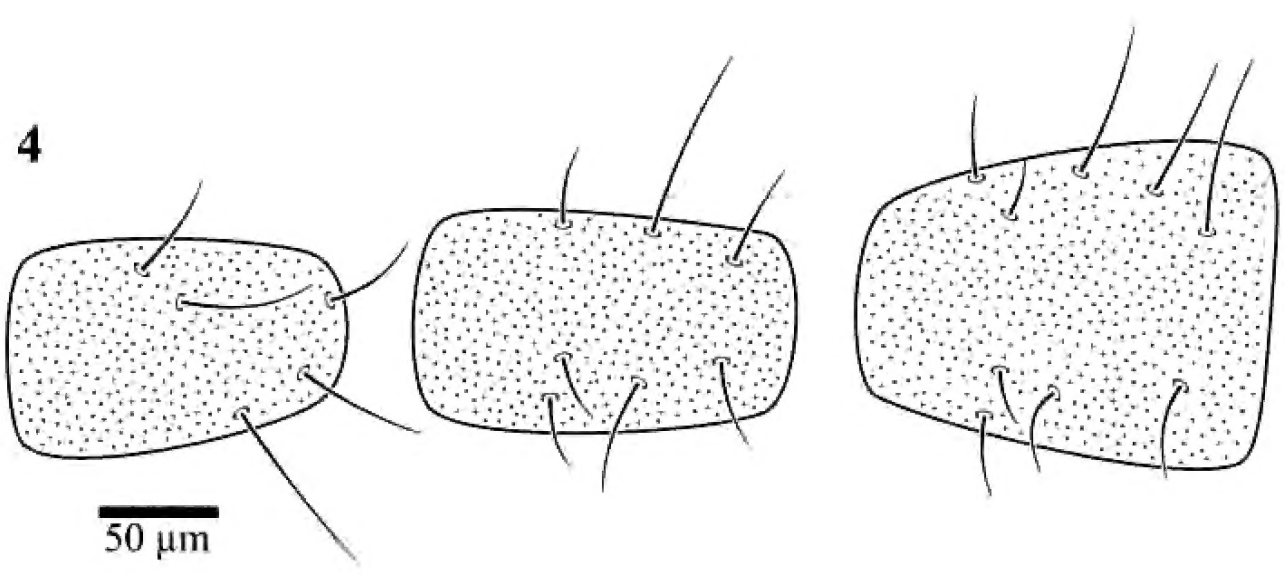
At first glance the postabdomen of *Meoneura issunboshii* sp. n. resembles several other *Meoneura* species with obvious long and setulose structures: *Meoneura amurensis* Ozerov, 1986 can easily be ruled out because the large and setulose structure projecting from the epandrium is identified as the surstylus by Ozerov (1986), and the prominent cercus with long setae of *Meoneura amurensis* (see Ozerov 1986: 85) does not occur in *Meoneura issunboshii* sp. n. *Meoneura krivosheinae* Ozerov, 1991 and the suspiciously similar *Meoneura forcipata* Sabrosky, 1959, also have both obvious large and setose structures projecting from the epandrium, too. But these structures are identified as surstyli, they are narrow basally and have dense setae restricted to their apical half (see Ozerov 1991: 8, Figs. 4-5, Sabrosky 1959: 21, fig. 8). There is no additional structure identified in the original descriptions of both species that resembles the surstylus of *Meoneura issunboshii* sp. n. *Meoneura stepposa* Ozerov, 1994 has a shorter, triangular surstylus with only one seta apically and a longer epandrium (at least twice as long as surstylus, see Ozerov 1994: 141). *Meoneura lamellata* Collin, 1930 has a shorter lamella that is only about as long as surstylus and a larger epandrium (see Collin 1930: plate III, fig. 7). *Meoneura perlamellata* Hennig, 1937 has a large setulose surstylus but no lamella and a longer epandrium (see Hennig 1937: 71, fig. 70).

Description. Male Length about 2.4 mm. Wing length = 2.1 mm. Head height = 0.5 mm. **Head**: black with only anterior half of frons dark brown. Antenna black. Arista without pubescence. Eye without ommatrichia. Ratio of maximum eye length : maximum eye height is 1 : 1. Ratio of posteroventral margin of gena closest to eye margin : maximum eye height is 1 : 2 (= 0.5). Frons microtomentose, frontal triangle shiny. Frontal triangle distinct, reaching anteriorly less than 1/2 distance from anterior ocellus to frontal margin. Face slightly microtomentose. Carina narrow. Postcranium microtomentose. Prementum about as long as labellum and only slightly wider. Palpus brown, almost half as long as the haustellum. One pair of distinct ocellar setae. Supralunular setae convergent. Four fronto-orbital setae, two anterior mesoclinate, two posterior lateroclinate. Two vertical setae. Postocellar setae parallel. One strong vibrissal seta; two supravibrissal setae, the ventral one distinctly smaller. Three strong genal setae, the anterior strongest and upcurved.

Thorax: Scutum completely slightly microtomentose, and covered with black setulae. Scutellum slightly microtomentose. Pleurae dusted to subshiny. Scutum with only one long and two inconspicuous smaller dorsocentral setae (two single setae broken in holotype). Two postpronotal setae; one praesutural seta; two notopleural setae; one supraalar seta; two postalar setae; one praescutellar seta; one apical and one lateral scutellar seta. One outstanding seta and some smaller setulae at posterior margin of anepisternum. One dorsal seta and one ventral seta on katepisternum. Wing completely covered with microtrichiae. Costa without obvious setae beyond radial vein R_1. Wing hyaline to light brown, veins light brown to white yellow. R_{4+5} almost straight. Knob of halter whitish yellow, base of haltere brownish. Legs black to brown. Fore femur with three strong posteroventral setae. Hind femur apically with one strong anteroventral seta. Fore coxa with one outstanding strong seta, middle coxa with two strong setae, hind coxa with one outstanding seta. Hind metatarsus ventrally with scattered yellow golden hairs only. Ratio of length metatarsus 2 : length tibia 2 is 0.7.

Abdomen: Tergites without obvious depressions or setulae tufts. Abdominal pleura with scattered setae on segments 3–5. Segments 1–5 narrow, ratio of width of tergite 3 : length of tergite 3 = 2.7. Tergites 2–5 each with a small lateral seta at the posterior margin. Tergite 5 with three longer setae at the posterior margin. Sternite 5 rectangular slightly longer than wide (Fig. 4). Sternite 5 with two strong laterally curved setae. Midventral tergite 7 distinctly developed. Protandrium distinct, longer than short epandrium and about 1/2 of length of tergite 5. Protandrium ventrally widely separated. Epandrium with two outstanding long setae and a few smaller setae (Fig. 1). Ratio of maximum length dorsally in the middle of epandrium (including cerci): maximum width of epandrium = 0.2. Cerci indistinct, slightly projecting, and with a few minute setulae only. Subepandrial sclerites fused with each other and fused with the narrow sclerotized hypoproct but the structures can be distinguished due to a different sclerotisation. No setula recognized on subepandrial plate. Hypoproct not projecting laterally, with few strong, short setae. No tooth on subepandrial plate. Surstylus as Figs. 1–2: falcated, dorsobasally slightly concave, with an indistinctly bulging base. Surstylus dorsally with four to five strong setae, some minute setulae in front of these and one long, medially directed setulae apically. Lamella large (Figs. 1–2) densely covered with long setae that are dorsally and apically longer than ventrally. Surstylus and lamella distinctly fused basally (Figs. 1–2). Postgonite (Fig. 3): distinctly sclerotized, with a broad base, elongated, pointed,





Figs 1–4. *Meoneura issunboshii* **spec. nov.** (drawn from holotype). **1**. Postabdomen, left, lateral view. **2**. Surstylus, left, lateral view. **3**. Postgonite, left, lateral view. **4**. Sternites, ventral view: sternite 3 (left), sternite 4 (middle), sternite 5 (right). Abbreviations: ce - cercus, ep - epandrium, la - lamella, su - surstylus.

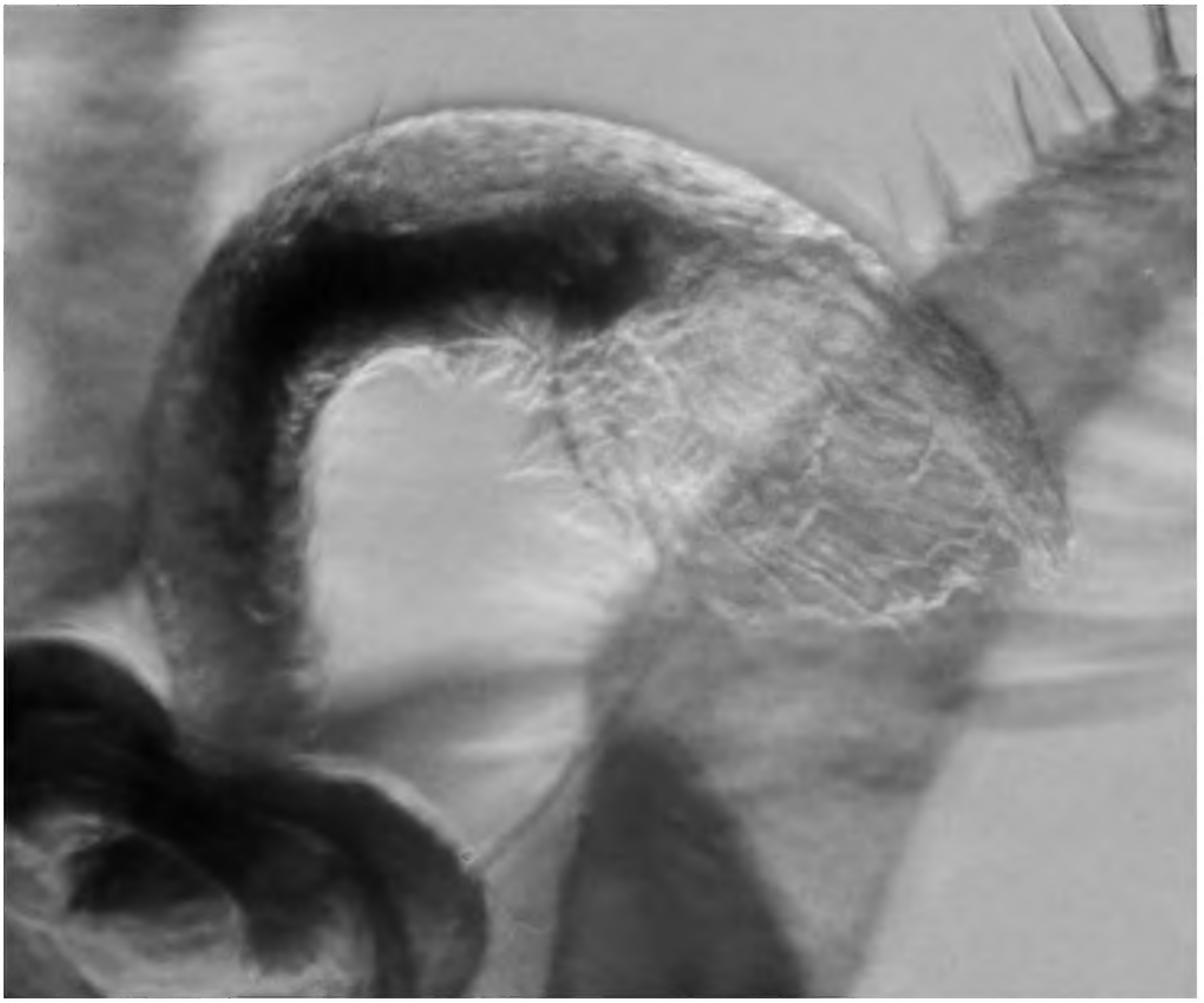


Fig. 5. *Meoneura issunboshii* **spec. nov.** (paratype, locus typicus, 11.xii.2011), distiphallus, lateral right view.

apically curved into hook-like prolongation. Distiphallus (Fig. 5) distinctly longer than epandrium, covered all over with setulae and apically with a small sclerotized area. Basiphallus sclerotized, long, narrow, distinctly widened at base.

Description of female abdomen. Tip of female abdomen identical to drawing of female abdomen of *Meoneura obscurella* (Fallén, 1823) as figured by Sabrosky (1987: 911, fig. 5). Abdominal pleura with dense setae on segments 4–5. Sternite 5 elongated, with two distinct setae on apical half. Sternite 6 elongated, with four setae on apical half. Sternite 5 almost square. Sternite 5 with one seta. Apical half of segment 7 ventrally with four setae of which two are always close together. Segment 8 at apical margin ventrally with two pairs of setae. Hypoproct almost square with one seta. Fused cerci elongate, with several setae.

Etymology. The name *issunboshii* is derived from the name of the Inch-High Samurai Issun-bŌshi (一寸法師) from a Japanese fairy tale. Issun-bŌshi showed that a minute man can be very successful.

Distribution. To date *Meoneura issunboshii* sp. n. is only known from the locus typicus, Mizumoto Park in Tokio, Katsushika, Japan.

Examined material. Holotype ♂: (1) "Mizumoto, / Katsushika word, / Tokyo, Japan / 10. I. 2010 / T. Tago leg."; (2) "Holotypus / *Meoneura issunboshii* / spec. nov. ♂ / det. Stuke, 2017". Male holotype is deposited in the Museum für Naturkunde der Humboldt-Universität, Germany, Berlin (ZMHB). Posterior part of abdomen dissected, macerated and stored in glycerine in a microvial pinned beneath the specimen. The remainder of the specimen is glued on a paper and in an excellent condition.

Paratypes: 9♂♂ 10♀♀ with same data as holotype but different collecting dates stored in the collection of the Osaka Museum of Natural History, Japan (OMNH) and in the private collection of Jens-Hermann Stuke, Germany, Leer (PJHS): 3♂♂ 1♀ 10.i.2010 (PJHS); 2♂♂ 2♀♀ 10.i.2010 (OMNH); 1♂ 2♀♀ 11.xii.2011 (PJHS); 3♂♂ 11.xii.2011 (OMNH); 2♀♀ 13.i.2013 (PJHS); 1♀ 13.i.2013 (OMNH); 1♀ 8.i.2011 (OMNH); 1♀ 26.ii.2012 (OMNH).

Remarks. *Meoneura issunboshii* sp. n. is found in the Mizumoto Park at about 5 m above sea level. Adults are recorded only in the winter months from November to January with temperatures of -3°C to -15°C. This might be the reason why the species has been overlooked previously. The flies aggregate on the bark of sun exposed parts of trees like *Zelkova serrata* (Thunb.) Makino and *Metasequoia glyptostroboides* Hu & W.C. Cheng. There they sunbathe, walk around, fly a short distance after disturbance, and mate. The forest floor was covered with woodchips. Although TT looked for, *Meoneura issunboshii* sp. n. was not recorded at neighbouring parks or forests in Tokyo.

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